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ABSTRACT

The eighth Annual Pacific Telecommunications Conference (PTC) proceedings contain 61 papers related to the conference theme, "Evolution of the Digital Pacific." These papers look at the ramifications of future technological breakthroughs and transitional needs. The first two days of the conference focused on state-of-the-art developments and set the stage for the final day, which addressed training and human resource requirements. The proceedings parallel the chronological flow of the conference. The initial selection provides the context for PTC '86 as set out by the four keynote speakers--Richard K. Jacobsen, Richard Sedgewick, Park Hyon-Tae, and Toru Uehara. Focusing on current telecommunications developments, the first day speakers discussed network applications, business strategies, and regulatory frameworks. The second day's speakers considered future developments and the latest services and applications were presented in plenary and concurrent sessions. On the final day, authors concentrated on assessing and managing the transition into a digital Pacific. Training programs and organizations were examined both from a "needs" and "operational" point of view. (THC)

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Telecommunications – Asia, Americas, Pacific: PTC '86 Proceedings

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Telecommunications–Asia, Americas, Pacific: PTC '86 Proceedings

Edited by Dan J. Wedemeyer and Anthony J. Pennings

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The Pacific Telecommunications Council

PTC '86 is organized by the Pacific Telecommunications Council, an international, non-governmental, non-profit organization. The council is regional in nature, the only body especially designed to embrace members from all the countries that play a role in the development of Pacific telecommunications. Its members are dedicated to promoting understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere – an area that includes North, Central, and South America; East, South, and Southeast Asia; Australia, New Zealand, Melanesia, Micronesia, and Polynesia.

Foreword

The Eighth Annual Pacific Telecommunications Conference, PTC '86, builds on the experiences and theme of PTC '85 – "Toward a Digital World." This volume contains work on the "Evolution of the Digital Pacific" received from more than sixty authors from the hemisphere – Asia, the Americas and the Pacific.

PTC has built a reputation for bringing together foremost leaders in government, industry, and academia to exchange ideas about the latest developments in telecommunications. This year many more papers were received than could be presented in the conference and, consequently, in this volume. The papers selected represent a broad range of perspectives characteristic of this annual open forum.

As you will see when you read the selections contained in this volume, the authors were challenged to look at the ramifications of future technological breakthroughs. Last year participants set out the characteristics of the digital Pacific. PTC '86 goes beyond these technical concerns and looks at the transitional needs.

The first days of the conference focus on state-of-the-art developments and set the stage for the final day which addresses training and human resource requirements. These proceedings parallel the chronological flow of the conference. The initial selection provides the context for PTC '86 as set out on Sunday by four distinguished keynoters. On Monday, plenary speakers and session presenters concentrate on current telecommunication developments. Topics include network applications, business strategies, regulatory frameworks, and so forth. Monday concludes with a round table discussion featuring key speakers. Tuesday's papers and speakers focus on future developments. The latest services and applications are presented in the plenary and concurrent sessions. Tuesday afternoon's format changes from paper presentations to interactive working groups. We have included some background papers developed for selected working groups in a special section of this volume. On the final day the authors concentrate on assessing and managing the transition into a digital Pacific. Training programs and organizations are examined both from a "needs" and "operational" point of view.

In total, the papers contained in this volume represent quality thinking on many interesting and complex issues. Each will serve as a valuable resource in the further development of Asian, American, and Pacific telecommunications.

The editors would like to thank all of the authors contributing to this volume. Their attention to detail and deadlines makes it possible for this publication to be available at the outset of this interesting and informative conference.

Mahalo and Aloha,

Dan. J. Wedemeyer
Anthony J. Pennings
Co-editors

Honolulu, 1986

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“Evolution of the Digital Pacific: International Carrier Perspective”

Richard K. Jacobsen, Vice President International
AT&T Communications

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EVOLUTION OF THE DIGITAL PACIFIC:
INTERNATIONAL CARRIER PERSPECTIVE

Richard K. Jacobsen
AT&T Communications
Morristown, New Jersey, USA

ABSTRACT

The globalization of commerce, the rapid economic development of the Pacific region, and the growing importance of telecommunications on international trade have spawned new technologies and new complexities that call for concentrated efforts to achieve mutual gain.

A new world is emerging in the Pacific region today ... a world of enormous opportunity in business, and of enormous potential in the conduct of everyday life.

It is a world that, despite vast geographic distances, is folding in on itself ... a world in which the barriers of time and space have been conquered ... a world made smaller and more manageable by an endless assault on the boundaries of communications and transportation technology.

Once a barricade, the Pacific is now a bridge. And the region, with its huge markets and untapped resources, is fast becoming the focal point of international trade.

Indeed, economic growth in the region has been nothing short of phenomenal. And if you track that expansion with the growth in telecommunications, a clear relationship stands out.

Communications and commerce parallel one another. It is a symbiotic relationship. A hand-in-hand process. A process that is unfolding at an unbelievable pace.

Think back to 1964. It was only then -- just 22 years ago -- that the first transpacific cable was installed. "TPC-1" -- still in service -- carries less than 200 voice and data circuits.

But by 1989, when TPC-1 is retired, a new cable -- with far more capacity and many more capabilities -- will span the Pacific. Using digital, lightwave technology, it will carry services unimaginable two decades ago.

Advances in satellite technology have been equally spectacular. The first generation of international satellites had less than 300 circuits. Today, 20 years later, satellite capacities are closing in on 100,000.

In the past 20 years -- in the last five years -- advances in telecommunications have been astounding. Speed and capacity records fall with ever-increasing frequency. And the quality of service is not only better, but the cost is less.

Can you imagine the technology that will emerge in the next 20 years? It will be every bit as incredible as today's capabilities seem in comparison with those of 20 years ago. As we view the 1960s, so too will 2006 view us.

Today, we are on the edge of a new era. Today, we have only cracked the door on an age brimming with possibilities for all nations, and for all walks of life.

But getting there won't be easy. New complexities abound. And many of the old ones still remain. Standards differ. Politics differ. States of development and forms of ownership vary. Barriers to trade in goods and information rise and fall.

Enormous obstacles. Enormous opportunities. Difficult challenges. But none that cannot be resolved. The key is cooperation. The result will be mutual gain.

Two themes are central to this conference. First, why is the Pacific emerging so rapidly as the fulcrum of international commerce? And second, what must we in telecommunications do to facilitate its growth?

First, the Pacific.

Today, the international arena is characterized by two important facts -- growing markets and globalization.

No longer is the conduct of business confined to domestic or regional markets. Instead, for companies of all sizes, the management of global resources and expansion into world sales have become conditions of success -- and often of survival.

While the traditional focus of this globalization process had been on the Atlantic region, the spotlight has since shifted to the Pacific. It's a wonder it didn't happen sooner.

The Pacific holds most of the world's people. It has tremendous natural and human resources. Friendly governments populate its shores. And economic integration is the general rule.

As a trading block, the Pacific is now of equal size and importance as the European Community. And with nations running the gamut from highly industrialized to relatively undeveloped, a wide spectrum of production and marketing opportunities exist.

The driving force behind the Pacific evolution has been the reduction of geographic distance brought about by technology. Air travel has shortened trips for tourists and business people. Advances in shipping have cut the cost of transporting goods. And developments, again, in telecommunications have toppled the remaining barriers to efficient and mutually beneficial trade.

Today, the movement and management of information is no longer a business convenience. It is a strategic resource that provides a real competitive edge.

Most nations now realize that an advanced telecommunications infrastructure is not merely a desirable goal but a precondition for social progress and economic success. They realize that multinational companies are scouring the world for new markets and new production systems, and that these companies are increasingly basing their investment and location decisions on the availability of advanced digital-based telecommunications systems.

The key word is digital. Digital is what multinational users require, and digital is what international carriers must provide.

Why?

There are as many reasons as there are applications. But at the heart of the matter is the plunging cost and soaring utility of digital machines.

The proliferation of computers, along with the growing need for communications between them, has provided a sizable market for digital transport, a market that now extends into voice and video transmission as well.

Advances in digital technology have made it possible to drastically reduce the cost -- and dramatically increase the capabilities -- of key components in voice, video and data systems. And it now makes sense to transmit all forms of communications through digital facilities.

Digital signals offer greater flexibility in the types, speeds and capacities of available services, depending on specific user needs. Users need the ability to reach many locations without the expense of a dedicated line to each. They want to be able to send and receive whatever they need -- from high-speed data, to voice, to facsimile, to video -- over the same digital line.

As these capabilities are made available, the increased number of users served will induce still more to use them. Through this synergy, the value of the services will increase, and the cost will be reduced.

To promote that use, international carriers must strive to achieve digital connectivity throughout the world. Just as we are deploying digital technologies within our nations, so too must we achieve digital linkage between them.

The key to that linkage lies in lightwave transmission. Lightwave -- with its broad bandwidth and increased capacity -- is the key to transmitting large amounts of digital information.

Lightwave cables have extremely low signal loss, high immunity to electrical interference, increased security, less delay in computer transmissions, and virtually error-free service. By enabling sharply defined pulses to be sent at a much faster rate, more and better services can be deployed, and greater economics of scale achieved.

One of the most interesting applications lightwave cables offer for business is in the area of video teleconferencing. The higher bandwidth combined with continuing improvements in electronic circuitry make it conceivable that we will someday enjoy international video teleconferencing with the same quality as broadcast TV, and with the same ease and frequency of a normal telephone call.

Next week, representatives from 22 telecommunications companies and administrations will take a big step in the lightwave direction by signing the final agreement for Hawaii-4/Transpac-3 -- the first fiber optic cable to connect North America to Asia.

Coupled with the deployment of TAT-8 from North America to Europe, as well as other, regional cable systems, we will by the end of 1988 achieve digital connectivity throughout the world's major markets. And by 1990, a fiber belt will span three-quarters of the earth. It is in every carrier's interest to participate. For when that occurs, all stand to gain.

Some have said that such a system of digital-to-digital lightwave systems will render satellites obsolete. But while there may be some adjustments, satellites will always be an important and valuable technology -- particularly in the Pacific, where the many island nations can be served more easily and more economically by satellite systems.

In addition, where the terrain is difficult or where a point-to-multipoint transmission is desired, satellites have had -- and will always have -- considerable advantages over cable.

And further, reforms at Intelsat and in other areas of the international satellite community give every indication that satellite carriers are preparing to compete effectively.

While critically important, these and other changes have complicated international telecommunications relations. And the challenge to international carriers in the months and years ahead is to bring a clarity of purpose to changing relationships and different points of view.

The growth of competition ... different states of domestic development ... the growing need for global service standards -- all these issues must be dealt with to reach a new state of international connectivity.

It is the irony of our time that the advanced products and systems available for information handling suffer from a communications problem. We simply cannot say we are serious about universalizing the Information Age until we make more progress at standardizing the media for information exchange.

To that end, we must all get behind the concept of worldwide, integrated, all-purpose information transport systems -- systems that will allow the movement of all forms of information between countries with the same ease that voice signals are exchanged today. It behooves all, therefore, to get on the ISDN bandwagon, not just in word, but in deed.

The ISDN concept will bind network architecture together. It will add a new dimension to the notion of connectivity. It will enable equipment on users' premises to communicate flexibly with the equipment of other users. It will provide access to expanded digital services. It will open up wide new avenues for information exchange.

We must recognize that international users do not view our services as separate, anymore than they view domestic services as separate. From their perspective, the least distinction, the better.

We need to develop a more fully integrated strategy that meets user needs regardless of where they are in the world. We need to fulfill their desire for capabilities that enable them to quickly introduce new business applications. We need to give them sophisticated control over network functions and capabilities.

Deliver, and we deliver economic expansion. Fail, and users will seek other solutions. Fail, and we stunt economic growth.

Today, inadequate or expensive telecommunications services act as a tax and restrain efficiency. Without modern, flexible and fairly priced telecommunications facilities, a country runs the risk of slowing economic development to the point where it grinds to an unnecessary halt.

The services we can provide present opportunities for constructive change. But if these opportunities are to be fully realized, a sense of vision must be shared by world telecommunications leaders -- a vision of the impact that information technology can have not only on business and commerce, but on education, medicine, and all of society's pursuits.

Today, the functions, capabilities and features possible are so great that the services provided will be limited largely by what the using public defines, and what government permits -- rather than by what the technology will support. The services potentially available could change society as much as any other force in history.

Think of the possibilities. Think of a Pacific region linked by a web of high-capacity, high-quality, and low-cost cable and satellite systems. Think of a world where information of all kinds is as abundant and readily available as any other resource known to man.

In my view, it is only a matter of time before telecommunications technology sweeps across the landscapes of industry, agriculture, education, government, and medicine -- leaving no aspect of our daily lives untouched and unchanged.

In a world filled with skeptics, my enthusiasm for the future is unbridled. I've seen extraordinary progress in my career, and extraordinary cooperation among the telecommunications entities of the world.

From my perspective, the fulfillment of this vision is only a matter of time. In my view, we can -- and will -- change the world.

Keynote Address

"Road to an Open World"

Richard Sedgewick, Vice President and Director of
Telecommunications, Asia Division
Bank of America

Notes

Keynote Address

"The Seoul Olympics: A Rendezvous Between Broadcasting and Telecommunications"

Park Hyon-Tae, President
Korean Broadcasting System

Notes

Keynote Address

"Evolution of Domestic Telecommunications in Japan"

Toru Uehara, Associate Vice President, International Affairs
Nippon Telephone and Telegraph

Notes

EVOLUTION OF DOMESTIC TELECOMMUNICATIONS IN JAPAN

Toru Uehara
Nippon Telegraph and Telephone Corporation
Tokyo, Japan

Establishment of the Information Newtwork System (INS)--a nationwide integrated digital network--is the most urgent and valued project of NTT, as telecommunications network is coming to take on greater importance with the approach of the 21st century. This paper starts with the description of the present status of telecommunications in Japan. It then expands to the INS concept, technologies supporting it and its model system now under trial use in the suburb of Tokyo. Prospects are also presented for future high-level functions of the INS.

I. Present Status of Telecommunications in Japan

A. Telephone network

At the foundation of Nippon Telegraph and Telephone Public Corporation in 1952, there were 1.4 million telephones in use. Continued growth and expansion saw full automation of the nationwide network in early 1979 and elimination of backlog in telephone demand in 1978. At the end of March 1985, there were 44 million subscribers using 66 million telephones throughout the nation. Of those now in use, about 80 percent are served by cross-bar switches, and about 20 percent by electronic switches. (Fig. 1)

Electronic switches are the key to functional improvement of the telephone network. Early in their introduction, speech paths made use of electro-mechanical contacts, and therefore a space-division configuration. But with the progress that has been made in semiconductor development, it has become possible to employ fully electronic paths using time-division digital techniques as well as fully electronified subscriber interface circuits using high voltage insulation techniques (as realized in NTT's D70 digital switches). In this form of switching, the information that travels over communications lines takes on digital form. It accordingly becomes possible to realize not only telephone but also such non-telephone services as data and facsimile transmission.

B. Data switching network

To promote the development of non-telephone communications, NTT started to provide telephone circuits for the use of transmitting non-voice information in 1971. As a result, considerable growth has been seen in the use of data and facsimile terminals connected to the telephone network. In addition, a digital data exchange (DDX) network has been constructed separately from the telephone network. Circuit switching service was begun in 1979, and packet switching in 1980. By the end of March 1986, circuit switching service will have been introduced in 200 cities of over 120,000 population, and packet switching in 500 cities of over 50,000 population. (Fig. 2)

C. Facsimile communications network

Because Japan's writing system is based on use of Kanji (ideographic Chinese characters), use in industry and elsewhere of facsimile devices has been broad-ranging. With employment of conventional telephone circuits for facsimile transmission, holding time tends to increase and long distance transmission costs result in a considerable expense. Hence, a facsimile communications network was put into service in 1981, in which high-speed digital circuits with signal storage and conversion functions are superimposed on the transit section of the telephone network, in order to make possible economical facsimile communications and such additional features as multi-address delivery and automatic reception. By the end of March 1986, this service will be expanded to 400 cities of over 70,000 population throughout Japan.

In 1984, functions to facilitate communications between facsimile terminals and computer centers were added. These include conversion of facsimile image information to/from computer code information, as well as paper size conversion to allow communications between 'A4' and 'A5' facsimile terminals. (Fig. 3)

D. Videotex communications network

The videotex communications system NTT has put into service in November 1984 enables users gain access to a computer center (called the 'CAPTAIN' center) over the telephone network for retrieval of a variety of on-line information to acquire such transaction processing services as stock information, ticket reservation, home shopping and home banking. In this system, a

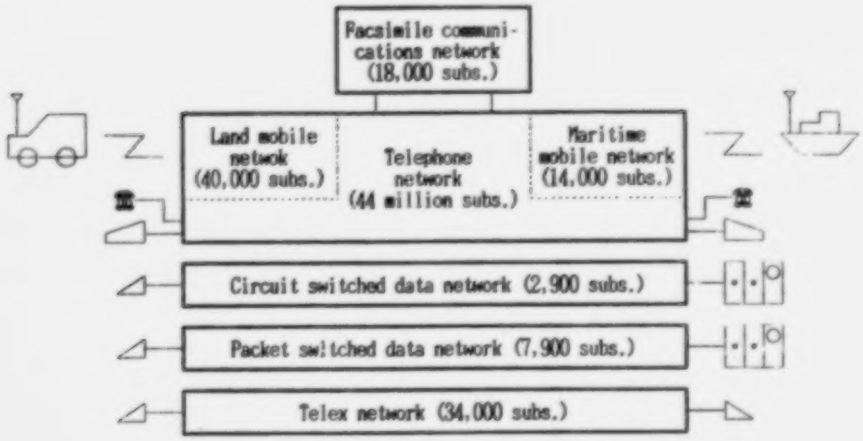
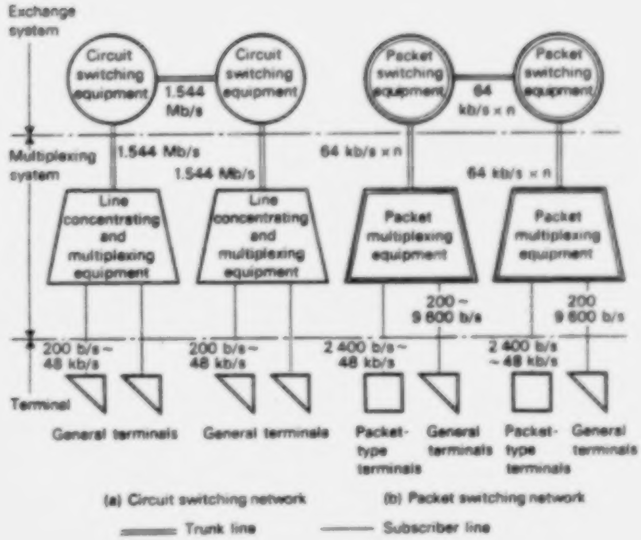

Facsimile communications network (18,000 subs.)
Land mobile netwok (40,000 subs.)
Telephone network (44 million subs.)
Maritime mobile network (14,000 subs.)
Circuit switched data network (2,900 subs.)
Packet switched data network (7,900 subs.)
Telex network (34,000 subs.)

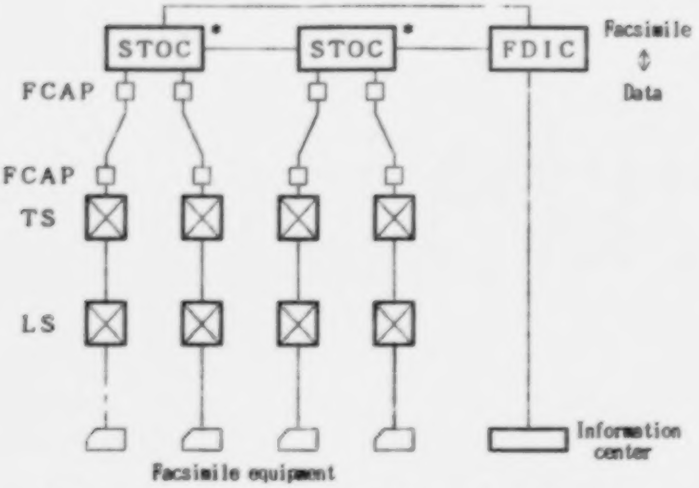
Fig. 1 Existing Telecommunications Networks in Japan (as of March 1985)


Exchange system
Circuit switching equipment
Circuit switching equipment
1.544 Mb/s
Packet switching equipment
Packet switching equipment
64 kb/s × n
Multiplexing system
1.544 Mb/s
1.544 Mb/s
64 kb/s × n
64 kb/s × n
Line concentrating and multiplexing equipment
Line concentrating and multiplexing equipment
Packet multiplexing equipment
Packet multiplexing equipment
200 ~ 9 600 b/s
200 9 600 b/s
200 b/s ~ 48 kb/s
200 b/s ~ 48 kb/s
2 400 b/s ~ 48 kb/s
2 400 b/s ~ 48 kb/s
Terminal
General terminals
General terminals
Packet-type terminals
General terminals
Packet-type terminals
General terminals
Trunk line
Subscriber line

(a) Circuit switching network

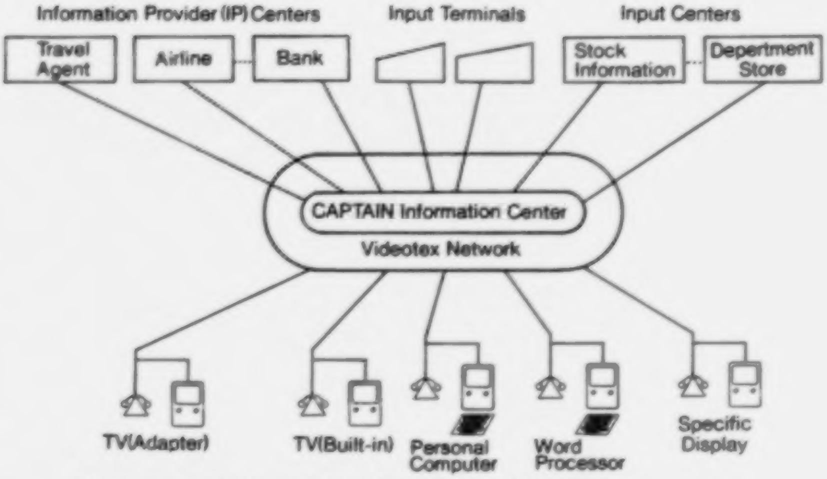
(b) Packet switching network

Fig. 2 Digital Data Exchange (DDX) Network Structures


STOC
STOC
FDIC
Facsimile
⇕
Data
FCAP
FCAP
TS
LS
Information center
Facsimile equipment

*) Perform size conversion, facsimile box and multi-address delivery.

Fig. 3 Facsimile Communications Network


Information Provider (IP) Centers
Input Terminals
Input Centers
Travel Agent
Airline
Bank
Stock Information
Depertment Store
CAPTAIN Information Center
Videotex Network
TV(Adapter)
TV(Built-in)
Personal Computer
Word Processor
Specific Display

✱Application Fields: Home Banking, Home Shopping, Data Base, etc.

Fig. 4 Videotex Communications Network

digital 'videotex communications network' placed between computer centers and toll switches in the telephone network can send signals in character code together with either mosaic display function codes, geometric display function codes or photographic display patterns depending on the terminal type. (Fig. 4)

II. Computer Communications in Japan

A. Use of computers

The total number of general-purpose computer installations in Japan reached approximately 150,000 in March 1984. The number of data communications circuits used by on-line computer systems reached about 223,000 circuits in the same period. Of these, 146,000 are leased circuits showing a yearly increase of 10-20 percent for the preceding five years. The remaining 77,000 are switched circuits. The growth in use of switched lines has been impressive, amounting to 30-40 percent per year over the same period. (Fig. 5)

The number of computer communications systems reached 8,500 systems in March 1984. The yearly growth rate is about 10-30 percent. NTT has developed about 80 systems, most of which are nationwide, large-scale systems. A breakdown by industry shows that merchandise distribution and banking systems are most common at present. Moreover, recent growth in production, sales, and inventory systems among manufacturers and trading companies is very noticeable. (Fig. 6)

B. Evolution of systems

On-line computer communications systems have evolved according to the following stages (Fig. 7). In doing so, they have been keeping pace with rapid innovations in the area of computer and telecommunications technologies, as well as with the expansion, diversification and sophistication of human activities in the presently evolving information society.

1) Specific use on-line system

This type of system is generally employed within one enterprise. Usually, computer centers are located at the head office, and connected with terminals located in branch offices by transparent leased circuits or digital data networks which do not have communication processing functions. Its function includes storage, processing and retrieval of information. Depending on the system, large scale databases may also be involved. This type is the largest in number and covers a large variety of business areas, including such services as seat reservations, banking and inventory management The range of system size also vary from small systems employed by small banks up to huge systems used by national government offices.

2) Shared use on-line system

This type of system is for a specific group of enterprises which share a computer center. With this system, relatively small-sized enterprises can avoid inherent managerial risks of spending of huge amounts of capital for system development, maintenance and operation costs that they would have to bear otherwise. This type is common in such business as banking, credit and hospital management.

3) Network type on-line system

This type of system mostly performs message switching functions. Information is exchanged between numerous organizations sharing the same network. In order to interconnect different kinds of computers, terminals and specific-use on-line systems, and to exchange information smoothly, this type of system contains plural communication processors which perform communication processing functions. These functions include conversion of communications protocols, message signal speed and code, communications media (voice, data and video), as well as storage facilities for multi-address, delayed delivery and mailboxing.

The network type on-line sytem is used for such business activities as money order exchanges and cash dispensing between banks, credit card authorization, and information retrieval using new media like videotex and facsimile.

4) Sophisticated network type on-line system

This type of system performs sophisticated communication processing as well as information processing (including database) functions, in order to achieve integrated rationalization of a variety of business enterprises connected to the system. This type will eventually serve as a stepping stone to the INS. Actually, for interconneciton between such wide areas of business enterprises as finance, manufacturing, transport, wholesale, supermarket and retail, development of a gigantic integrated network is planned.

III. Development of the INS

A. Concept

As the range of human social activity has begun to expand, the need for reliable, high quality transmission of vast quantities of diverse information has rusulted in turn. Advances in computer processing speed and capability have also been remarkable. When this processing power comes to be tied to telecommunications, a new information society emerges. The creation, distribution, use, etc. of information takes on new shapes and aspects. One natural result of this evolving integration of computers and telecommunications is what we are developing at

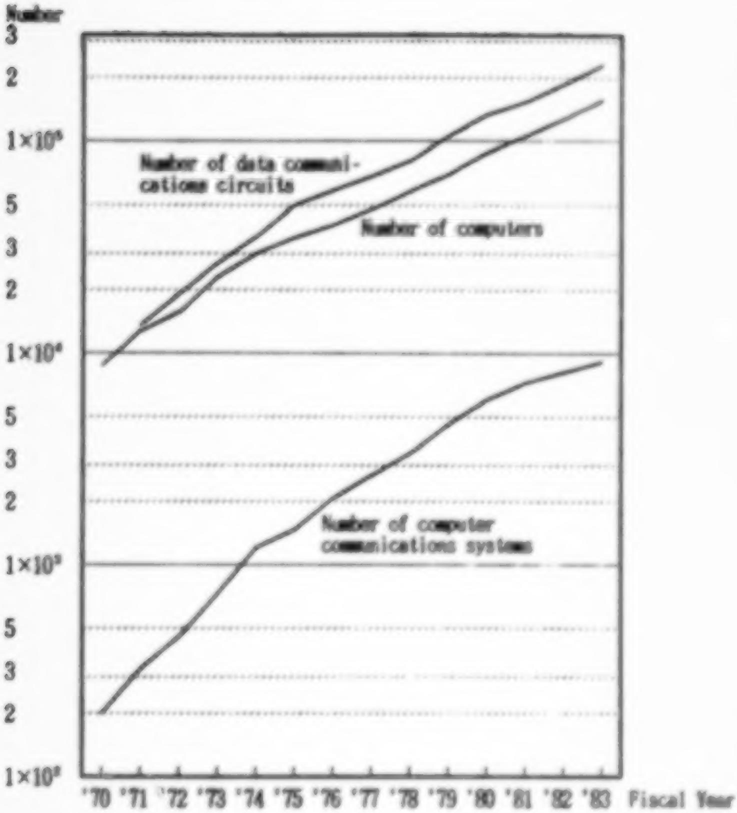


Fig. 5 Numbers of Computer Communications Systems, Computers and Data Communications Circuits in Use in Japan

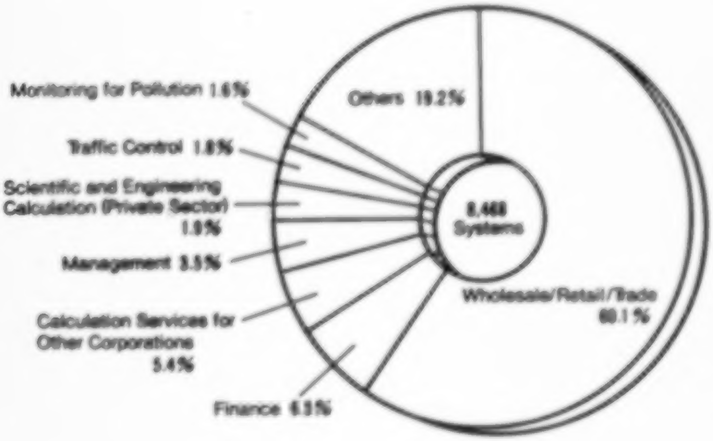


Fig. 6 Use of On-line Systems in Japan (as of March 1984)

NTT as the Information Network System (INS).

Philosophy behind the development of the INS is a uniform supply of a rich variety of communications services to anyone, anywhere and anytime in a fair and convenient fashion at reasonable cost. To make this philosophy a reality, however, numerous qualitative expansions, conversions and reconfigurations of the telecommunications system are necessary. Several major tasks are listed below.

1) The present plurality of individualized telephone and non-telephone service networks has to be integrated into a single all-inclusive digital system.

2) As a result, bit volume can be taken as a guideline for determining communications charges.

3) With the implementation of optical fiber and large scale satellite communications technologies, the factor of distance will be less significant.

4) While working to achieve more economical networks, attempt will be also made toward realization of advanced information technologies, as well as high level and multifarious communications services (Fig. 8)

B. Technologies supporting it

1) LSI and digital technologies: The area where the most obvious progress has been made in the latter half of the 20th century is semiconductor technologies centering on large scale integration. Particularly in regard to LSI memory elements, every 5 years has seen a one-order rise in the scale of information they store. As a corresponding reaction, every 5 years has seen a one-order drop in memory cost.

2) Optical fiber technologies: Based on epoch-making progress with low-loss optical fibers, NTT began in 1981 to introduce optical fiber systems on a nationwide scale. From March 1985, the F-400 system will be traversing the length of Japan, serving as a basic transmission line backbone. Plans for 1987 as they stand now are to implement a 1.6 Gb/s transmission system capable of carrying 23,000 voice channels or 48 TV channels. As a result, transmission costs will drop drastically, and price differentials due to factors of distance will be substantially reduced.

3) Large capacity satellite communications technologies: In 1983, the CS-2a and CS-2b communications satellites were launched, both having a capacity of 4,000 channels. In 1987, the CS-3 will be put into orbit. To achieve a lower per-channel cost, a 2-4 ton, 100-200 thousand channel satellite is being develped. In order to make effective use of it within the small land area of Japan, multi-beam techniques with highly precise spot beams are being planned.

4) Network technologies: Even though the protocols used for the communications network was defined when constructing computer networks, upper layer protocols could be set in an individual manner in the past. However, as more diverse non-telephone and integrated terminals are coming into use, standardization up to the highest levels is needed to facilitate interconnection of different computer networks, shared use of individual terminals and increased user-friendliness. Accordingly, although study is now going on at CCITT, ISO and other organizations in regard to suitable protocols for the user/network interface, the need for early standardization is increasing.

5) Information processing technologies: Progress in establishment of intelligent processing is one thing that is needed to improve software productivity. Improved serviceability in regard to switching and communication processing systems will also likely to contribute to the enhancement of the human/machine interface. For instance, real time communications between people speaking different languages can be realized by way of automatic translating machines if technologies for understanding the meaning of sentences are developed.

C. Model system

A model system project is being carried out to verify technical feasibilities as well as social benefits regarding various related systems. Its construction took three years and the service started in September 1984. It is now providing services for 1,200 non-telephone terminals and 9,000 telephones. Subscriber line transmission systems employ both metallic and optical fiber cables, and various types of terminals in subscriber premises are connected to digital local switching or broadband switching systems. In the 64 kb/s system, a digital toll switch is equipped with gateway functions for various types of communication processing. Storage and conversion of data takes place, when necessary, and connections are made with different information processing centers. (Fig. 9)

Through the trial use, it will be possible to confirm communications efficiency, ease of use, and many different types of information delivery/receipt technologies and equipment.

Digital services being tested are:

video conferencing,
Japanese teletex,
multi-media communications service,
digital interactive videotex,
facsimile communications network service,

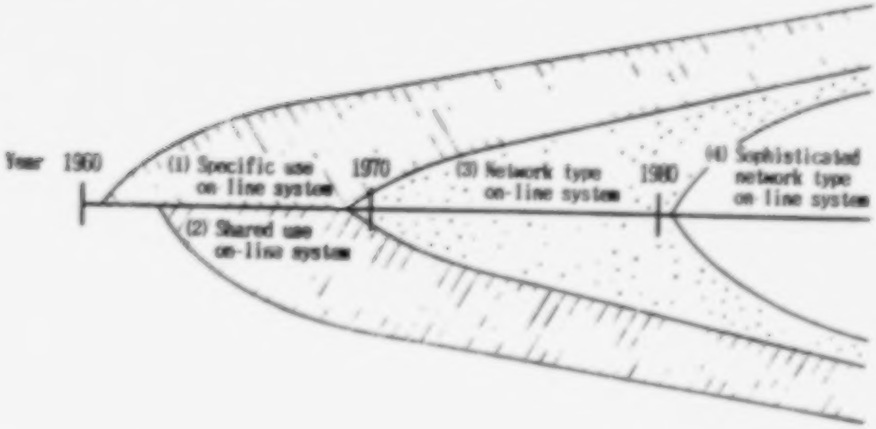

Year 1960
(1) Specific use on line system
(2) Shared use on-line system
1970
(3) Network type on-line system
1980
(4) Sophisticated network type on-line system

Fig. 7 Stages in On-line Computer Communications System Evolution

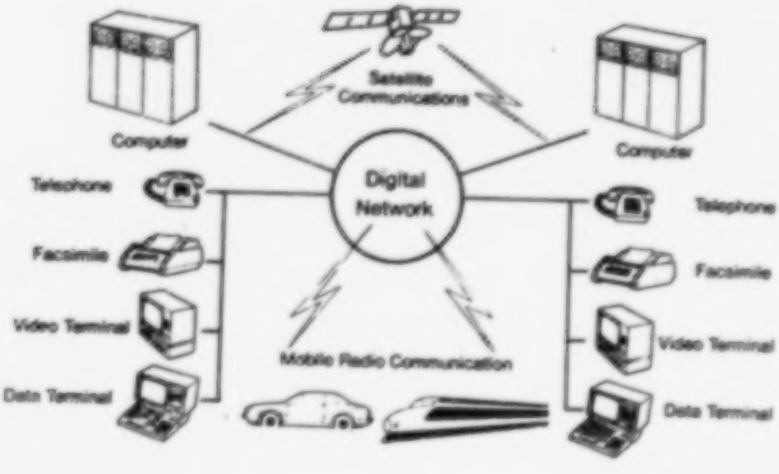

Satellite Communications
Computer
Computer
Digital Network
Telephone
Facsimile
Video Terminal
Data Terminal
Mobile Radio Communication
Telephone
Facsimile
Video Terminal
Data Terminal

Fig. 8 Conceptual View of the INS

digital pay telephone/digital telephone and home shopping and home banking services.

D. Future plans

A fundamental condition for INS establishment is digitization of the telecommunications network. However, the telephone network, which already provides sufficient coverage, still mostly consists of an analog type of system. Digitization of this network will accordingly proceed through the replacement of old analog equipment with new digital equipment as the former becomes obsolete. In the meantime, new demands for data and related communications services will be met by DDX expansion. The telex network will be amalgamated into the DDX network in 1986, as will the telegram network in 1987.

Social implications of INS services will also be investigated under the model system project. Results gained there were reflected in exhibits at the International Scientific Exposition in Tsukuba Academic Town in 1985. In 1987, D70 switches with INS capabilities and with remote control systems for smaller offices will be installed in 60 major cities. It will then be possible to effect nationwide end-to-end digital service if users so desire. Subsequently, integration of the digital data switching network and a digitized telephone network should make it possible to satisfy a wide range of user needs. By 1995, the non-telephone network will have finally been integrated into the INS.

Hence, a mature INS will be operating from 1995 on. Wide varieties of services of increasing sophistication that are tied to the digital network will undoubtedly be realized in an ongoing fashion. (Fig. 10)

IV. Conclusion

The communications network is coming to take on greater importance as it appears more and more likely to provide the infrastructure for the information-intensive society now developing with the approach of the 21st century. This communications network will need not only to supply information transmission functions, but also to be equipped with communication processing and information processing features in order to provide high-level services to its users. The INS is a means to fulfill these aims.

One area where great advances can be anticipated in providing high-level functions to any member of the public is through the development of networks equipped with high intelligent functions capable of voice and other complex signal recognition. It should become possible to implement language translation functions in the telecommunications network, which then can serve to remove one of the barriers separating the nations of the world, thus making a profound contribution to promote peace on earth.

On the other hand, after being privatized on April 1, 1985, NTT has been actively and flexibly promoting new business operations, expansion of operational areas and formation of a wide range of improved working environments to stimulate its employees. This will be done effectively through taking advantages of the technical and managerial know-how and resources that has been accumulated over its years of operations.

NTT has been planning overall entry into new business areas, searching for new business ideas and undertaking feasibility studies regarding new business ideas. One of our latest subsidiaries established in October 1985 is the NTT International Co., Ltd. (NTTI). It undertakes such jobs as designing, construction, sales, operation and maintenance of overseas telecommunications and/or data processing facilities, as well as overall engineering and consultation relating these activities, to contribute to foreign telecommunications improvement and advancement.

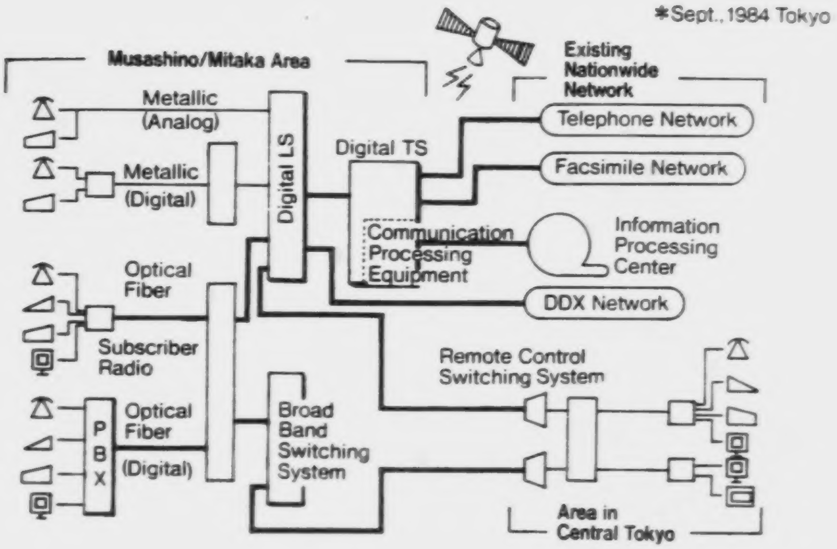

*Sept.,1984 Tokyo
Musashino/Mitaka Area
Existing Nationwide Network
Metallic (Analog)
Metallic (Digital)
Digital LS
Digital TS
Telephone Network
Facsimile Network
Communication Processing Equipment
Information Processing Center
Optical Fiber
Subscriber Radio
DDX Network
Remote Control Switching System
P B X
Optical Fiber (Digital)
Broad Band Switching System
Area in Central Tokyo

Fig. 9 INS Model System Configuration

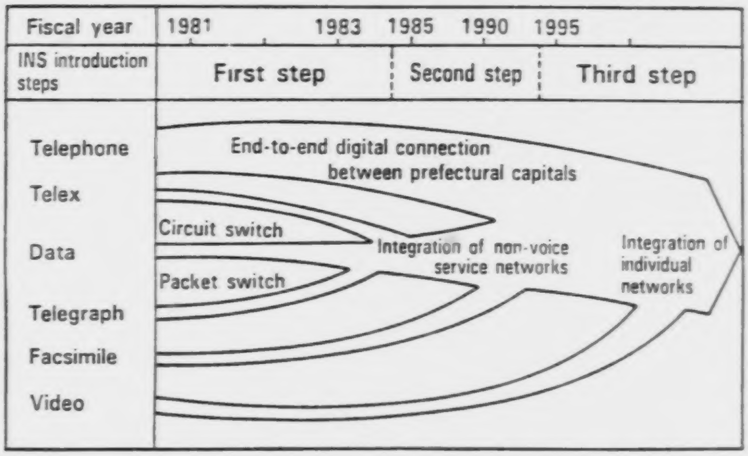

Fiscal year
1981
1983
1985
1990
1995
INS introduction steps
First step
Second step
Third step
Telephone
Telex
Data
Telegraph
Facsimile
Video
End-to-end digital connection between prefectural capitals
Circuit switch
Packet switch
Integration of non-voice service networks
Integration of individual networks

Fig. 10 INS Network Development

"Pacific Satellite Telecommunications: Past, Present and Future"

Steven Pilcher, Assistant Division Manager, Commercial Systems
Hughes Aircraft Company

Notes

"The Digital Pacific – Evolution or Revolution?"

R.J. Olsen
General Manager, Hong Kong Telephone Company, Limited

Notes

THE DIGITAL PACIFIC -
EVOLUTION OR REVOLUTION?

R.J. Olsen
Hong Kong Telephone Co., Ltd.

"Twenty years ago, telecommunications was one of the world's most boring industries. Economics and technology have turned it into one of the most exciting. It has become the key to the biggest industrial change of the next few decades: the developed world's shift to an information economy. The plunging of an industry long dominated by cautious utilities into innovation-driven chaos has upset and irritated many people. They ought to be exhilarated instead" - so said the headline of a recent article in the British weekly magazine, "The Economist."

The new telecommunications is a product of the computer revolution. When data processing machines were built out of single transistors wired together on circuit boards and telephone calls were switched electromechanically, computers and telephones had little in common. They are now technological twins. Both are based on the microchip; both run on computer programs - some 70% of the development cost of a modern telephone switch is in software.

There is no doubt that digital techniques - invented some 20 years ago - have come of age and whilst it is tempting to talk at length about the exciting changes these techniques have to bear on our industry, I will concentrate my remarks on the implications of the digital age to developing or Third World countries in the Pacific.

The Pacific Needs a Digital Voice

Remember that the Pacific basin has been identified by forward thinking economists as the area of major economic growth in the next century. If economic and telecommunications development are to go hand in hand, it follows that the economic potential of the Pacific basin can only be realised if modern digital telecommunications facilities are made available to it.

The Pacific region consists of a diverse group of countries in various stages of technological and economic evolution. It includes not only the West Coast of North America, but also Japan, Australasia, China, the ASEAN countries of Southeast Asia and the Pacific Islands.

Nowhere better than this region illustrates the relationship between telecommunications and economic development. Here we have economical and technological extremes which vary from the sophistication of the eastern rim of the Pacific basin (that is, the West Coast of the United States) to the relatively undeveloped land mass on the western rim of the Pacific (that is, China). We have, too, complete contrasts between relatively sophisticated and economically diverse city communities, such as Hong Kong or Singapore, and the island communities of the South Pacific with their widely dispersed populations and relatively unsophisticated economies.

Why Ignore a Bargain?

The notion that developing countries require telecommunication systems thaat are more technically advanced than those generally in use at present in highly industrialized nations may seem bizarre. It might be thought that in a poor country where villagers may have to walk hours or even days to the nearest telephone, even the most primitive system would be better than none. In one sense that is true, but many developing countries are now beginning to plan comprehensive national and international systems for the first time. The technology they choose will influence economic viability and operational efficiency for them until the end of this century and beyond.

It would be tempting indeed for these communities to snap up obsolescent but still efficient electromechanical or analogue telephone exchanges which are becoming available from developed countries who are changing to digital systems, or from manufacturers who still have brand new analogue exchanges sitting "in stock" and are prepared to make these available at less than the cost of manufacturer.

Why should the developing parts of the Pacific ignore these generous offers? Why should it not take advantage of the substantially discounted prices that are available?

The principal reason for any developing country to go digital now is that a fundamental revolution is taking place in telephone transmission and switching technology for the first time since the turn of the century. The change from analogue to digital has only started to gain pace in the present decade; by the end of the century, it will be all pervasive.

Rapid convergence of computer and telecommunications technologies provided the initial stimulus for the digital revolution. The multiplicity of telecommunication services of the future will employ the same basic digital technology throughout. Problems of compatibility will be eliminated because the analogue systems themselves will be made redundant.

It is in this context that developing countries need to make decisions about the type of system they intend to install. Paradoxically, they are in one sense in a more favorable position than the industrialized countries of the west which have billions of dollars tied up in technically obsolescent equipment, all of which will need to be written off at a rapidly accelerating speed. Developing countries, by comparision, are able to move directly into digital technology precisely because of the relative poverty of their existing telecommunications resources.

Digital Decisions

Two factors are likely to influence Third World decision makers:

Efficient telecommunications services are vital to developing countries. Economic development will be inhibited unless adequate means of communications exist.

Economically deprived developing countries cannot make do with old-fashioned equipment entailing large numbers of costly telephone lines in the streets. They need the latest techniques as urgently as advanced industrialized countries, although not necessarily on the same scale. Instances of telecommunications facilities in developing countries being under-utilized are rare indeed.

The case for developing countries to move directly to digital systems is compelling. It means in some cases that they can leapfrog a whole epoch in the evolution of telecommunications technology. They can be certain that the infrastructure they are creating is soundly based and sufficiently flexible to cater to all foreseeable future demands. That is the long-term gain.

The short-term advantages are equally impressive. Recent experience has shown that it is cheaper by one-third to connect telephone users by digital rather than analogue systems. Digital networks diminish the need for non-earning capital to be invested in the high burden of spare plant, which is inevitably associated with electromechanical systems. The most striking example of the economies that can be achieved is in the provision of expensive line plant, which in analogue systems can represent almost half the capital cost.

This factor must carry particular weight with larger developing countries who plan to establish their own telephone material manufacturing plants but have no copper within their borders. The new technology offers the opportunity to reduce reliance on large quantities of copper. Instead they may be able to use indigenous supplies of the world's most common mineral element - silicon, the main component of sand. This will obviously have consequential benefits for their international trading balances.

New technology provides an equally important bonus in terms of staffing and maintenance. Developing countries do not possess a reservoir of well-trained artisans or technicians. It would take many years and massive investment to produce the large number of technicians needed to maintain a relatively labor-intensive, traditional telecommunications system. Such an exercise would in any case be a profligate waste of scarce resources. It would be the same as producing a generation of expert blacksmiths in the age of the automobile.

Fortunately, the new technology now available is well suited to the educational pattern already existing in many developing countries. Most have many unskilled workers and an educated elite who do not envisage of future as technicians.

In this socioeconomic environment, the high degree of self-diagnostic capability built into computer-controlled digital telephone exchanges and digital transmission systems attains singular importance. It means that the efficient running of an extensive network can be monitored and controlled by a relatively small cadre of highly trained people.

Theory and Practice

All this pontificating sounds fine in theory, but how can it be carried into effect? Is it just a lot of hot air idealism from the privilege bestowed by this microphone?

The answer to that is, "No." I have put my money where my mouth is - or at least my company, the Cable and Wireless Group, has - and is continuing to do so on a substantial scale:

- In Macau, a Portuguese administered territory of China, adjacent to Hong Kong, Cable and Wireless secured a franchise in 1981 to operate the domestic and international links. The decision was made then to "go digital" with the result that more than 30,000 subscribers are now connected to new digital exchanges and remote line units. All the advantages of digital technology are being realized.

- In China, we entered into a joint venture in November 1983 to form the Shenda Telephone Company to operate services in the largest of China's Special Economic Zones, Shenzen. We took over a mere 2,000 lines, operating on an analogue exchange against a background of acute pressure to develop facilities that would satisfy the dramatic demand growth of the zone. The end of 1985 saw 11,000 telephones installed in what is probably the world's first fully digital telephone company. (Yes, we threw away the analogue we inherited.) We are planning for 70,000 subscribers by 1990.

- In Hong Kong, the scale is obviously bigger - over 1.7 million subscriber lines, with a penetration of 40 telephones per 100 population - but we are rapidly going digital. At the end of 1984, all major exchanges were connected by some 7 million meters of optical fiber cable, giving them the largest urban fiber network in the world. By 1988, we will have digital switching capability in every exchange of the territory as we move step by step towards ISDN.

- Internationally, the Cable and Wireless Group is also ready in terms of experience and expertise. We have had data and packet

> switching established since 1979 and have established Hong Kong's first international digital telephone exchange. Major steps have also been made in international digital transmission.
>
> From Hong Kong, we are building digital links to neighboring regions. Macau, Shenzen and Guangzhou, already linked by a variety of transmission systems, will be complemented by the addition of new digital links, catering to the requirements of dramatic traffic growth due to intensifying trade.
>
> A digital microwave link is being constructed between Hong Kong and Macau. A 560 megabits optical fiber cable system is being planned between Hong Kong-Shenzen and Guangzhou which will interconnect with other digital systems in China that we have participated in developing.
>
> Looking to the sea, several digital transmission pathways are being planned. A Hong Kong-Japan-Korea submarine optic fiber cable is planned to supplement existing cable capacity between Hong Kong and Japan which will be fully utilized by the late 1980's. This cable, scheduled for completion in 1990, will connect with a trans-Pacific digital cable connecting Japan, Guam, Hawaii and the U.S. Mainland, due to be operational by 1988.
>
> Concurrently, digitalization is planned in the air. At our earth stations in Hong Kong, we have already installed Time Division Multiple Access facilities in readiness for digital satellite communication. A digital system called Intermediate Data Rate (IDR) is already working via the Indian Ocean satellite to the Whitehill Satellite Communiations Center in the U.S., a complex owned by Mercury Communications Ltd, a wholly-owned subsidiary of Cable and Wireless plc. By 1988, IDR will be able to work via the Pacific Ocean to Australia and, by 1990, to Japan and the U.S.A. We will be using INTELSAT IBS service to communicate with Australia, Canada, Japan, the Philippines and the U.S.A. by 1987.

Digital Productivity

The 45 million telephone calls that Americans will place every hour this year are only a drop in the flood of information that will be coursing electronically around the globe before the century is out. Man is adding to his information transmission capacity at an astonishing rate: a single company can now put together a private telecommunications network which has more capacity than all the public networks on earth had in the early 1960's. Many individual companies within the Pacific region generate telecommunication volumes far greater than that of some of the smaller member countries of the region.

If the telephone were the passive household instrument that almost everybody born before 1965 still instinctively thinks of it as, this explosion would not be happening; the urge to chatter is not that strong. The telephone and the information network it represents have become something else - one of the world's most effective means of raising productivity.

Revolution

It would be a mistake to imagine that the argument for the deployment of leading-edge technology in developing countries has been won.

There are still advocates of intermediate technology. They assume a plentiful supply of labor and a relatively low level of sophistication. Sometimes proponents of this approach disguise their ideas under the name of appropriate technology, but Third World countries understand that what they are really being offered is second best.

Yet second best is precisely the kind of solution they cannot afford. There is already a wide gap between the information-rich and information-poor countries; it should not be allowed to grow so wide that it becomes virtually unbridgeable. Communications technology provides the power to organize.

It would be naive to assume that efficient telecommunications systems will solve problems of poverty and deprivation. But without them, Third World nations will find themselves falling further behind. The Pacific cannot afford a digital evolution. It requires a digital revolution.

KOREAN STRATEGIES FOR A DIGITAL WORLD

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Korea Telecommunication Authority
Seoul, Korea

Yong Son and Sang Chul Lee
Choong-Ang University
Seoul, Korea

1. ABSTRACT

It is for telecommuinications operating entities in each developing country to make their own decisions about the strategy toward network digitization. Digitization of the telecommunications network is the first stage of development toward an ISDN, which will be followed by the second stage of the integration of non telephone networks. The third and final stage will be the integration of the telephone networks with data networks. Telecommunications decision makers should therefore draw on the best possible sources of information and advice when making these decisions.

2. INTRODUCTION

The first generation of Electronic Switching System (ESS) appeared in the early 1960s. But within a few years these were superseded by the system which reflected new concepts based on the convergence of communications and computers. Over the same period digital transmission techniques have also been greatly improved.

Computer control of exchanges, time-division switching and the transmission of information in digital form are the essential factors of the new concepts and seem likely to stimulate technological developments for years to come. Advances in the design of telecommunications system, in components and above all in semiconductor techniques such as Very Large Scale Integration(VLSI) will continue and will reduce costs and improve performance, capability and reliability.

The recent development of microelectronic, space and optical fiber technologies made it possible to spread new telecommunications services around the world. Besides voice and text, huge quantities of visual information are being transmitted. Videotex systems connect subscribers to data banks and display economic, financial and scientific information as text or graphics on a television screen. In addition, services such as video-conferencing, teletex and electronic-mail are widespread.

All of these services could be integrated into a single global network called Integrated Services Digital Network (ISDN). An ISDN comprises digital switching, computer control and optical fiber digital transmission and satellite channels. Specialized satellite systems are capable of automatic connections with ships, airplanes and even land vehicles. High power satellite transmitters with large antenna opened up a new dimension for global communications by reducing the size and cost of earth stations. With such promises of the future in mind, decision makers have to consider all the options available today.

3. TRENDS IN TELECOMMUNICATIONS NETWORK

Telecommunications network consist of subscriber terminals, subscriber lines, local exchanges, toll exchanges and interexchange circuits.

Subscriber terminals have evolved from the simple telephone set designed to provide basic voice telephony. The current trend is toward increasing intelligence in the terminal, enabling subscribers to perform a range of functions which enhance the telephone utility. The terminals associated with other services such as facsimile and data have also become more versatile and sophisticated. Already the concept is emerging of a single device capable of acting as a multipurpose terminal for text, data and other non-telephone services as well as being used as a telephone. An ordinary telephone line will be able to carry many of these services and devices of this kind would make it easier and cheaper to provide non-telephone services in rural and remote areas.

Subscriber terminals are normally connected to local exchanges by a physical pair of conductors. The physical conductors are expensive, representing around 30% of the total capital cost of plant in urban areas. However, in highly populated areas, a suitable local network distribution system can be planned and installed that can be expanded economically. Local networks use overhead or buried cables in various size and flexibility points, allowing sufficient capacity to accommodate new subscribers. Various means of concentrating traffic are available so that more than one subscriber may share each physical pair of conductors.

However, local distribution represents the major problem of providing telephone service in rural and remote areas. In rural areas, subscribers may be at a distance over 30 to 50 kilometers from the exchange and the terrain and environment may be inhospitable. Local network cost may represent as much as 70 to 80% of capital plant cost which are themselves normally 4 to 5 times of urban cost.

An alternative to physical conductors, especially in rural areas, is radio telephony. Ultra High Frequency and Super High Frequency systems have direct line of sight paths between transmitter and receiver at a distance of 50 to 70 kilometers. In practice the environment and terrain reduce this distance. Improving the utilization of frequency spectrum is possible by using the cellular radio concept and other methods of dynamic frequency assignment.

Satellite system is also suitable for a large number of circuits and is becoming an attractive solution for thin-route rural systems, especially when a greater distance has to be linked or where the installation of radio repeater stations is impossible. The cost of a satellite communications service includes investment in a satellite transponder and earth stations. At present earth stations are expensive but the cost is becoming moderate.

Manual systems with operators setting up connections using key plugs and jacks are still used in developing countries. If attended for 24 hours a day, these provide reasonable service with low investment, low consumption of power and simple maintenance.

In automatic analog systems, speech is converted into an electrical signal with varying frequency and amplitude and calls are connected through separate switches in the system. The oldest automatic switching system is the step-by-step system with electromechanical switches. Although still extensively used, it becomes obsolescent.

Cross bar systems operate at higher speeds, are less costly to maintain, and give subscribers greater capabilities. But this system also will be obsolescent and it is expected to remain in a limited lifetime only to provide for the expansion of existing systems.

The most recent generation of analog ESS have Stored Program Control(SPC). In SPC systems the control functions are performed by a computer, and the switching matrix can use solid state electronic crosspoints. Advantages include extensive remote operation and maintenance facilities, built-in test and signaling units and practically no open contacts, which make them less sensitive to dust and humidity. Normally SPC exchanges are built in compact form and so require air conditioning, especially in hot and humid climates. These systems are not yet obsolescent, but most manufacturers are switching their product line to digital ESS.

In a digital ESS voice or signal is converted from the analog signal to a coded form consisting of high speed ONE/ZERO or ON/OFF pulses. Pulses of different conversations are separated from each other by discrete time intervals and switched in turn by the time division switching system so that many calls are multiplexed by the same switch. Digital exchanges are cheaper to install and maintain than analog exchanges particularly in the larger sizes. Among the advantages of digital swiching are its compatibility with computers and potential cost and space savings when operated in conjunction with digital transmission systems.

The links carrying calls between exchanges may be symmetrical pair cable, quad cable, coaxial cable, optical fiber cable, or terrestial or satellite link. The choice of medium depends upon bandwidth or traffic volumes to be carried, the distance and terrain to be covered, the performance required, the distribution of the traffic and the cost. Interexchange transmission system in the past were analog but are now being superseded by digital systems.

Technological developments are reducing cost and improving the quality of service. Optical fiber cable is particularly suitable for high capacity routes, leaving longer distances between repeaters, further reducing cost and increasing reliability. Optical fiber cable will be replacing coaxial and quad cable systems as the preferred medium. Microwave systems are particularly suitable for medium and high capacity routes in inhospitable terrain. Coaxial or optical fiber submarine cable is also an economic choice in numerous cases for long distance or international transmission.

4. DIGITIZATION TOWARD AN ISDN

The advantages of digital switching and transmission systems have been proven. Such systems are introduced piecemeal into an existing analog network. But their full merit is realized only when they are used to create a fully digital network built to an integrated set of standards.

Such a network carries data traffic as easily as voice traffic and therefore is used by many types of service. The result is economies of scale and resilience when traffic on particular services peaks. The computers within exchanges monitor and control the behaviour of the network as a whole system and open up new capabilities and techniques of operation. The flexibility of digital systems also simplifies the physical design of networks so that the limitations on serving large areas from a single exchange are reduced.

The advantages of a fully digital network are so great and every planning decision in Korea Telecommunication Authority(KTA) has been made with the concept of such a network in mind.

The toll switching systems were completly digitized with No.4ESSs and AXE-10s and the Circuit Switched Digital Capability(CSDC) will be available in the near future. As electromechanical switching systems being removed, digital local switches such as 5ESS and/or S-1240 will be introduced in urban areas from 1987 and beyond.

Digital local switches such as AXE-10 and TDX-1 have already been introduced in order to digitize all the rural exchanges by early 1990s.

TDX-1 is a Korea indigenous digital switch developed by the Electronics and Telecommunications Research Institute in the Republic of Korea.
Indigenous development of telecommunications system in a developing country could provide many benefits:

- Foreign exchange problems could be lessened.
- Developing countries could become more self-reliant by reducing the dependency on foreign manufacturers.
- Problems in operation and maintenance could be minimized.
- Economic activity in domestic industry could be maximized.

Optical fiber transmission system as digital backbone trunks will be completed by 1988 in support of Integrated Digital Network(IDN) implementation plan and all other toll trunks will be digitized by early 1990s. Digital Subscriber Carrier System and Time Compression Multiplex System will be introduced in the near future.

The CSDC will provide end-to end digital connectivity. The CSDC, which is expected to be available as a tariffed service, is an important step toward an ISDN, a public end-to-end digital telecommunications network capable of supporting a wide spectrum of present and emerging user needs. Like the ISDN, the CSDC is service independent. The CSDC provides a 56 Kbps digital path over the Public Switched Telephone Network (PSTN) to customers whose lines are terminated on ESSs with the CSDC feature.

Digital terminals will be developed and demonstrated as Customer Premises Equipment(CPE) during 1986-1991.

- C IV type Facsimile
- Teletex (56 or 64 Kbps)
- Videotex (56 or 64 Kbps)
- Video-conferencing (56 Kbps)
- Digital telephone

Although data communication or even broadband communications is not that significant at the moment as is plain old telephone service it is nevertheless considered highly important that by adopting the digital approach right from the moment a telephone network is installed, the infrastructure is built for an expansion in that direction in the future.

5. DATA COMMUNICATIONS SERVICES

A Packet Switched Data Network (PSDN) service was introduced in 1983 as a public data transmission service to make connections with overseas PSDNs and the domestic public data transmission service was also introduced in 1984. The tariff is based on the volume of data transmitted instead of distance. So this service is favorable for the users who transmit data to distant destination in a small volume.

The leased line service had been a fast growing data transmission service until PSDN was introduced in 1983 but the growth rate has been slowed down since then.

Also dedicated PSDN services for AP-TELERATE and REUTOR-MONITOR are available so that users can retrieve the latest financial informations such as exchange rate, interest rate, stock prices, and oil prices etc.

Republic of Korea Government has an ambitious master plan to construct an integrated computer network system consists of the 5 basic computer networks such as Public Administration Network, Banking Network, Research and Education Network, Security Network, and National Defence Network.

The system is planned to be completed in the late 1990s. As one of the subsystem, Administration Computer Network Project will be carried out to take care of Resident Registration, Employment Information, Land Registration, Tax Information, Economical Statistics Information, and Automobile Registration.

As the New Telecommunication Laws permit private companies to provide computing service, 26 organizations have participated in this business. Now there are 10 software houses, 4 hardware vendors, and 4 research institutes.

A Remote Computer Service (RCS) provides computing power with application software via PSDN. Overseas data bank services such as DIALOG(U.S.A.), JOIS(JAPAN), and GSI-ECO(France) are also available. These data bank services are provided without any markup so that the users can retrieve the information at the same access charges as the users in U.S.A., Japan, or France.

A data base providing National Congress Library Bibliograph Information has been developed for a trial so that about 200,000 records may be retrieved in English or Korean alphabets(Hangul). National data bases have been developed and will be opened to public some time this year.

Electronic mail-box services such as NOTICE, DIALCOM and EASYLINK are provided via PSDN. Hangul Electronic-Mail system will be available some time this year. The number of users will be increased rapidly when Electronic-Mail system is merged with the telex network in 1988. The primary users of this service are Government organizations and Seoul Olympic Organizing Committee (SLOOC). This service provides Hangul word processing, calculation, file editing, and Hangul Electronic-Mail for message exchange.

A NAPLPS type Videotex system for the 1986 Asian Games is under development. The service items are Guide to Korea, Places for tourist, Hotels, Shopping centers etc.

Also, this system will expand the service items including transaction services such as home shopping and home-banking. The number of users will grow rapidly as personal computers prevail.

Various Value Added Network(VAN) systems are under development to enhance the efficiency and productivity of our national economy. Systems under study are Electronic Fund Transfer System (EFTS), Physical Distribution System, Commodities Transaction System, and Trading System.

6. CONCLUSION

Digitization of the telecommunications network is the first stage of development toward an ISDN, which will be followed by the second stage of the integration of non-telephone networks. The third and final stage will be the integration of the telephone networks with data networks.

The accelerated pace of technological progress has widened the range of choices and complicated the problems in developing countries when making their decision. The situation of each developing country has to be considered on its merit. Although the latest high technology is not always the best solution, introducing digital systems would make good sense in many networks particularly where existing infrastructures are not advanced. However, conversion of a network from analog to fully digital will take many years of evolution.

Various considerations should guide operating entities when making their choice of technology. A major objective must be to meet present and expected future demand. To do so economically requires careful long-term planning in order to select the most appropriate technology. Existing analog system should be utilized to the end of its economic life rather than replaced prematurely by digital system. Digital system may be introduced along with analog system, but the difficulties of operating a network with many different systems must be taken into account.

Network planners should also take into account the availability of capital resources, the impact of network investment on the finances of the telecommunications administration, the implications for staff, the need for building space, and other non-technical problems.

Formulating, updating and implementing long-term strategic plans is an indispensable process. While prescribing the general guide lines for the development of an ISDN and providing a basis for financial, personnel and other non-technical decisions, plans should be flexible enough to tolerate unexpected changes in technology.

Experienced and skilled planners are scarce even in industrialized countries. Special efforts are needed to develop human resources with new management skills while exploiting those which already exist. Those responsible for planning need to bear in mind that the most appropriate strategy for any country is one that makes optimal use of existing human, material and financial resources.

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TWO PIONEER OPTICAL UNDERSEA CABLE LINKS

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U.S.A.

1. Abstract

In the year since PTC-85, AT&T has moved optical undersea cables from the laboratory and factory into the field. This paper describes briefly our first two systems, one repeatered and the other unrepeatered. These systems demonstrate the technology and designs which will be used in the first transatlantic and transpacific lightwave cable links.

2. INTRODUCTION

The past year was marked by two optical undersea cable systems of historic importance. In September 1985 AT&T laid Optican-1, a high bit rate, repeatered link between two of the Canary Islands. The second system was a long unrepeatered link which provides two-way communication between a shore station and a floating offshore platform.

3. THE OPTICAN 1 LINK

3.1 PURPOSE

The Optican 1 installation had two important purposes: (1) to serve as a test and demonstration vehicle for the technologies and designs which will be in the Transatlantic-8, Hawaii-4, and Transpacific-3 cables, and (2) to serve Telefonica, the Spanish telephone company as an important traffice link between the islands of Tenerife and Gran Canaria.

3.2 OPTICAN 1 LAYOUT

Figure 1 shows this link. Repeaters R1 and R3 were part of the initial installation. Repeater R2 was added to the system in a pre-planned operation to prove our ability to make deep water repairs. AT&T Bell Laboratories designed the repeaters for Optican-1. AT&T Technologies manufactured the repeaters in their Clark, New Jersey plant.

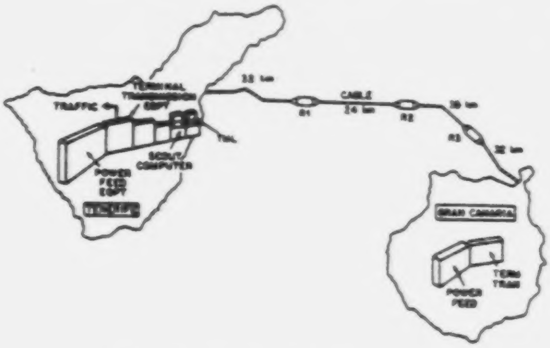


FIGURE 1 OPTICAN-1 (POST REPAIR TRIAL)

The SCOUT (acronym for System for Control of Undersea Transmission) at the Tenerife terminal is an extremely powerful monitor, maintenance and restoration tool. It can monitor error rate and can measure receiver AGC voltage and laser bias of any regenerator at any repeater. SCOUT's restoration functions include control of switches to insert a standby laser transmitter, or to switch in a complete protection path in any regenerator section. In addition, SCOUT can loop the system at any repeater in either direction for purposes of fault location.

3.3 SYSTEM DEPTH

Figure 2 shows the depth profile along the cable route. The Canary Islands and ocean bottom around them are volcanic. This is reflected in the ruggedness and steep slopes shown on the profile, factors which made slack control and proper cable placement a real challenge. The maximum depth is 3300 meters.

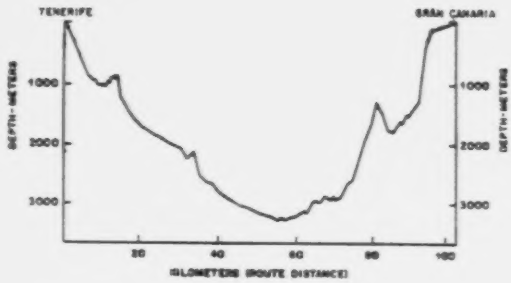


FIGURE 2 DEPTH PROFILE

3.4 SYSTEM PARAMETERS

Table 1 summarizes several key features and parameters of the Optican-1 link. These are identical to those of the TAT-8 and Transpac-3 systems.

TABLE 1 - OPTICAN 1 PARAMETERS

Number of Fibers	6(4 wkg, 2 Protection)
Line Rate,each fiber	295.6 Mb/s
Line code	24BIP
System Interface	140 Mb/s
Channels per Interface Port	2016
Channels per Interface Port	1920
Channels per System	7680
Conversations/System (with Bit Compression Multiplex,BCM)	40,000 (approx.)

At the time of the Optican-1 installation, AT&T performed a handling trial of the branching repeater which will be used in TAT-8. This trial is shown in Figure.3.

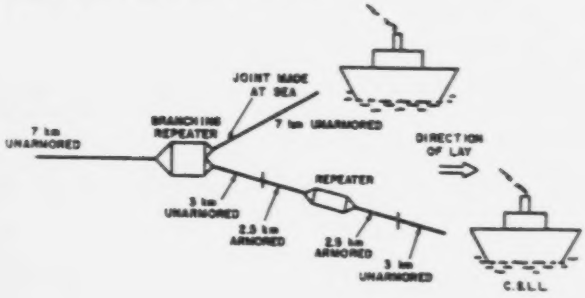

JOINT MADE AT SEA
BRANCHING REPEATER
7 km UNARMORED
7 km UNARMORED
DIRECTION OF LAY
REPEATER
3 km UNARMORED
2.5 km ARMORED
2.5 km ARMORED
3 km UNARMORED
C.S.L.L.

FIGURE 3 MINI SEA TRIAL

Laying proceeded from left to right. First, Cable Ship Long Lines payed out an anchor followed by 7 km of unarmored cable. From this point on it was a two-ship operation. CS Long Lines payed out the branching repeater and the bottom leg while a second cable ship payed out the 7 km upper leg of unarmored cable. Note that the lower leg included 11 km of cable and a regular repeater, plus transitions going from unarmored to armored and armored to unarmored cable. This Mini Sea Trial showed that the branching repeater can be successfully deployed and recovered to cable or hardware.

5. LONG UNREPEATERED LINK

5.1 SYSTEM LAYOUT

In November 1985 AT&T's Cable Ship Salernum completed an unrepeatered system extending from a land terminal to an offshore moored platform. See Figure 4, which diagrams this 147 km link. The cable was laid with enough slack to follow the ocean floor until it reaches the vicinity of the platform. Here, the riser cable travels up from the bottom and over a saddle on the subsurface buoy. Finally, a suspended portion extends from the subsurface buoy to the platform.

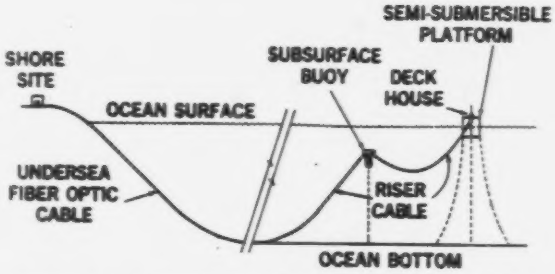

SEMI-SUBMERSIBLE PLATFORM
SHORE SITE
SUBSURFACE BUOY
DECK HOUSE
OCEAN SURFACE
UNDERSEA FIBER OPTIC CABLE
RISER CABLE
OCEAN BOTTOM

FIGURE 4 REPEATERLESS LINK CONFIGURATION

A single anchor line moors the subsurface buoy. Since the submersible platform is moored in deep water and is exposed to weather, it moves to different locations, depending on water and wind velocity. The suspended portion of the riser cable accomodates this platform motion without risk to the cable.

5.2 SYSTEM PARAMETERS

Table 2 presents a summary of important system parameters.

TABLE 2 - LONG REPEATERLESS SYSTEM

System Length	147 km
Fiber Type	SL, Single Mode
Fiber Proof Test	2% Elongation
Cable Design	SL, Embedded Core
Optical Wavelength, λ	1.55 µm
Optical Source	BH Laser
Optical Detector	Pin Diode
Data Rate	T1, 1.544 Mb/s
Line Coding	Dipulse

This unrepeatered link sends signals 147 km without regeneration. To realize this distance, operation is in the fiber's "third window" at an optical wavelength of 1.55 µm. Here the cable loss averages only 0.24 dB/km. The application calls for a T-1 information stream (1.544 Mb/s) in each direction. Data is dipulse coded, giving an optical line rate of 3.088 Mb/s.

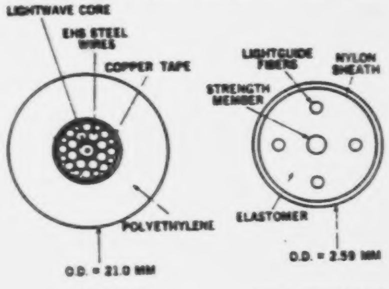
5.3 FIBER AND CABLE DESIGN

5.31 LIGHTWEIGHT CABLE

AT&T drew the fiber for the two pioneer links in their Atlanta, Georgia plant which is the world's largest producer of optical fiber. The fiber is the standard SL 5D depressed cladding design. A plastic coating protects the glass, and color codes the fibers. A tension test to 200,000 psi (1.38 GPA, or 2% elongation) assures mechanical integrity and long term reliability of all fiber. Oxy-hydrogen flame fusion splices join each fiber length to the next. For splices the proof test is more severe, 300,000 psi (2.07 GPa, or 3% elongation).

Simplex Wire and Cable Company at Newington, New Hampshire produced all cable for both links. Cooperation with AT&T Bell Laboratories was extremely close.

The bulk of the two routes used the standard SL lightweight cable. Figure 5 shows the 4-fiber version of this cable. (The SL design can carry up to 12 fibers. In the Optican 1 link it carries 6 fibers) The right side of the figure shows the core, much enlarged. A resilient elastomer embeds and cushions the fibers, while a nylon sheath surrounds the embedded fibers. Making the fiber core is the first major stage of manufacture.



CABLE

LIGHTWAVE CORE

FIGURE 5 SL LIGHTWEIGHT CABLE

The second major stage is the cabling operation. Two layers of extra high strength steel wires (300,000 psi or 2.07 GPa) are stranded over the core. In the same operation, the cabling line forms, welds and swages the copper tube tightly over the steel strand. Steel and copper form a pressure cage over the fiber core, in addition to providing the longitudinal strength for laying and recovery.

In the final stage of manufacture, the extruder places polyethylene over the copper power conductor. This PE jacket insulates the conductor from the sea water and protects the cable against mechanical damage.

5.32 RISER CABLE

As the platform moves in its watch circle, the suspended section of the riser cable flexes. This action imposes more severe requirements on the riser cable than those on the bottom-supported cable. See Figure 6.

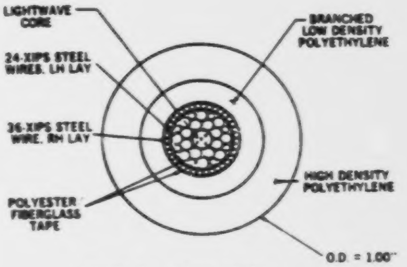

LIGHTWAVE CORE
24-KIPS STEEL WIRES, LH LAY
36-KIPS STEEL WIRE, RH LAY
POLYESTER FIBERGLASS TAPE
BRANCHED LOW DENSITY POLYETHYLENE
HIGH DENSITY POLYETHYLENE
O.D. = 1.00"

FIGURE 6 RISER CABLE

The riser cable meets these more severe requirements by three added features:

(1) an added layer of steel with pitch direction opposite to the direction of the two inner layers,

(2) layers of polyester and fiberglass, both under and over the extra steel layer, and

(3) an extra outer layer of black-pigmented high density polyethylene.

These three features make the cable essentially neutral in tension-torsion coupling, give it added longitudinal strength, and provide superior abrasion resistance.

5.4 SYSTEM OPERATION

The system transmits a standard T-1 (1.544 Mb/s) bit stream in each direction. It also transmits power from the shore station to meet all on-platform needs.

5.41 TRANSMISSION OPERATION

To understand operation of transmission paths and equipment, refer to Figure 7.

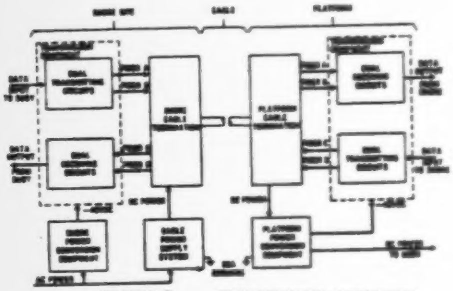


FIGURE 7 TRANSMISSION EQUIPMENT

Data from the shore station drives duplicate shore transmitting circuits. Optical output from duplicate 1.55 μm lasers drives fibers A and B. On the platform, optical outputs from fibers A and B feed duplicate receivers. Electrical output from these receivers travels through a transfer switch and protection control circuit to a single data output. From data input on the shore to data output on the platform, equipments and fibers are duplicated.

If the working path fails, output automatically transfers to the surviving spare path. This arrangement provides exceptionally high availability even if one or both terminals are unattended. Data traffic from platform to shore travels over similar duplicate equipment and fibers.

5.42 POWER PATH OPERATION

Figure 8 presents the power path and equipment. The shore terminal transmission equipment draws power from the local 117 VAC source. A 48 V rectifier and DC/DC converters further process the power to low regulated voltages for the terminal's solid state circuits.

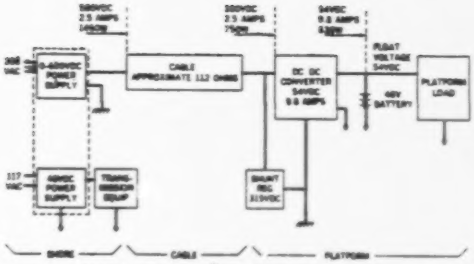


FIGURE 8 POWER CONVERSION AND PATH

The power path between shore and platform consists of the metallic cable structure as one conductor, and the sea as the other conductor. In the terminal, 208 VAC drives a 0-600 VDC power supply which drives 2.5A into the cable. Because of cable resistance, approximately 300 V appears at the platform DC/DC converter. This converter supplies up to 9.8A to the platform 48 V battery to meet all platform needs. Numerous redundancy and protection features assure high availability of power and minimize risk to personnel.

6. CONCLUSIONS

The two lightwave undersea cable systems described here have been installed by AT&T. All elements of both installations are performed as their designers intended. The repeatered Optican-1 link and the 1.55 unrepeatered system are operating error-free. Span margins for both installations significantly exceed system requirements.

With the successful completion of these two pioneering lightwave undersea systems we enter a new age. In this age, systems like these and their successors will provide low-delay, economical digital highways for all kinds of voice, data, computer, facsimile, and video services. Applications of future systems will range from increasingly long repeaterless systems to 8000 km transoceanic links. In the next few years, a network of advanced optical undersea systems will lace the seas of this planet and provide us with communications of unparalleled quality, economy, and universality.

7. ACKNOWLEDGEMENTS

Literally thousands of people contributed in important ways to the design, manufacturer, and successful installation of these two pioneering systems. The author joins with communications users in thanking all of them. My special and personal thanks to Elaine K. Stafford and Robert L. Lynch who provided figures and additional materials for this paper.

Telecom Australia's ITERRA Services

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Satellite Services Project Team

Abstract

Telecom Australia's satellite services, with the generic product name ITERRA, are briefly described. Their derivation from the inherent advantages of satellite over terrestrial techniques are discussed. Several application examples are given.

Introduction

Telecom Australia, the national provider of telecommunications services, over the years has built up an extensive terrestrial network of pair cable, HF through microwave radio, coax and optic fibre bearers. The establishment of an Australian domestic satellite system in 1985 has offered still another technology with which to extend and improve Telecom's products and services.

ITERRA, an Aboriginal word meaning "be quick" was chosen as the generic name for satellite services offered by Telecom Australia.

The Telecom network is continually being expanded using the latest technology. It was therefore important that the ITERRA products and services be tailored around the inherent advantages of satellite over other telecommunications techniques. This paper first summarizes those inherent advantages, next describes the ITERRA services themselves, and finally gives some applications of ITERRA services in typical customer networks.

Inherent Satellite Characteristics

A geostationary satellite can receive from and transmit to any location within its coverage area. In the case of the Australian satellite this includes the entire country plus some offshore areas(for a complete description of the Australian domestic satellite, see Reference 1). From this basic characteristic, three conceptual inherent advantages arise:

1. The cost and timing of providing point-to-point services are independent of the distance between service terminals. Terrestrial techniques involve costs that increase with increasing separation of terminals and require that the service be "built out" over a period of time.
2. Once a signal has been beamed up to the satellite, it can be received at as many locations as needed for the relatively small cost of the receiving equipment in each location. The satellite can broadcast a signal to many locations more cheaply than by using a land line to each place even though terrestrial systems may be already installed nearby.
3. A satellite channel can be used now between two locations, then between another two locations, and later still between yet other locations. This multiple - access capability is a feature which terrestrial systems do not have.

Beyond these three inherent characteristics the satellite has another feature which may be valuable for improving the reliability of communications. It is, simply, an alternative to the existing terrestrial network. It is unlikely that both satellite and terrestrial systems serving a location would fail together.

The first advantage suggests the use of the satellite for long-distance applications such as between Perth or Darwin and southeast Australia. As high-capacity digital radio and optic fibre systems are installed, however, the current cost advantage of the satellite in this application will diminish or possibly disappear. For distant parts of the Outback where low traffic requirements make it uneconomic to install these high capacity terrestrial systems, the satellite is likely to remain the preferred service method for quite some time.

The second advantage, aside from its obvious applicability to radio and TV distribution and direct broadcasting, offers an attractive transmission vehicle for services such as one-way videoconferencing, data dissemination including both data broadcast and asymmetrical data communications, and text distribution.

The third advantage is particularly useful for low-density and infrequent, itinerant communications requirements.

The "not terrestrial" feature is expected to be used in private networks for customers who are especially concerned about reliability and survivability, for example in data networks for major financial institutions.

Current Telecom Satellite Services

ITERRA Network Service (Figure 1)

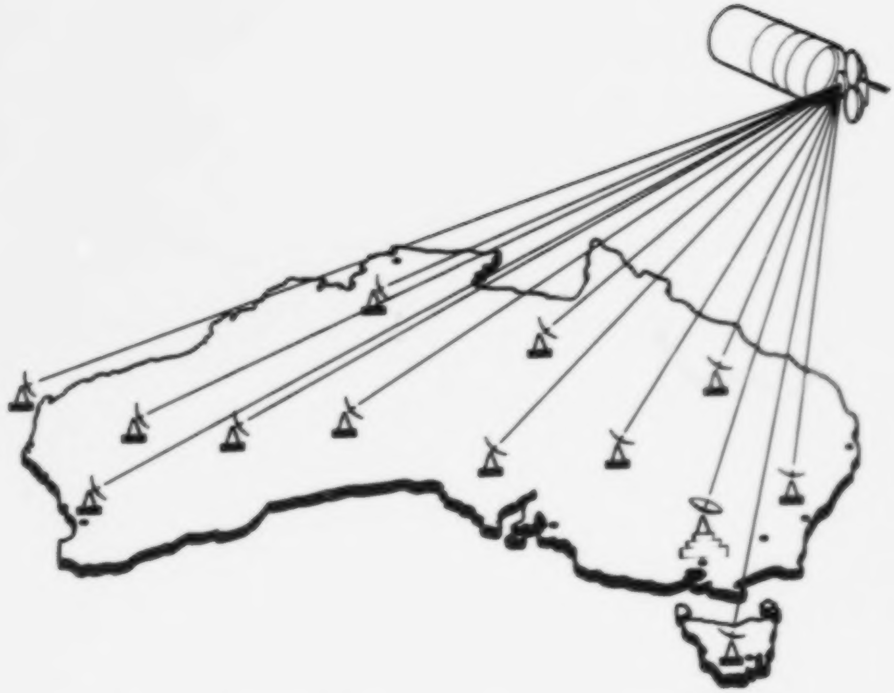

Fig. 1 ITERRA Network Service

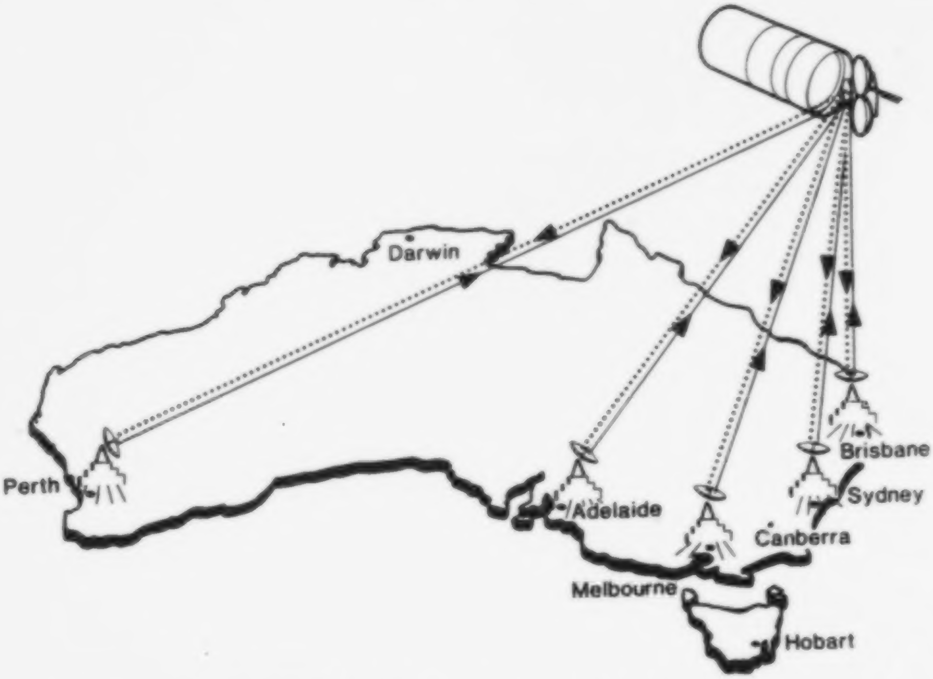
Darwin
Perth
Adelaide
Brisbane
Sydney
Canberra
Melbourne
Hobart

Fig. 2 ITERRA Business Services

Using the ITERRA Network Service (INS), Telecom offers analogue telephone and data services to any location in Australia. The customer's remote earth station can be equipped with between one and fourteen voice circuits. Actual voice circuits through the satellite are allocated as required for calls by Telecom's central control earth station located at Bendigo, Victoria. It is at Bendigo also that these voice circuits are connected to the national telephone network.

INS customer earth stations typically employ a 3.7 or 4.6 metre dish, although at the edges of the satellite transmit beam a 6.4 metre antenna is needed. Most INS earth stations will be fixed to concrete foundations. A transportable version on a standard - width trailer is also available.

The usual range of customer equipment and switching systems can be used with INS - from telephones or a small business system with smaller installations to a PABX for a ten to fourteen circuit earth station. All services normally available over analogue lines can be provided: telephone, Datel up to 4800 bps, Videotex and Telememo.

ITERRA Business Services (Figure 2)

In the second half of 1986 Telecom Major Earth Stations (TMES) will be providing ITERRA Business Services in Brisbane, Sydney, Melbourne, Adelaide and Perth. If warranted by customer demand, additional TMES will be installed in other cities. The TMES are configured around the 2 Mbps level of the CEPT hierarchy for digital transmission. Thus, the services accessible via TMES include:

- Digital voice at 64 or 32 kbps using PCM or ADPCM codecs
- Data at a variety of rates including 4800 and 9600 bps, 48 kbps, and 2048 kbps.
- Compressed video and high speed facsimile.

The TMES will have 11 metre antennas, and will be co-located with Telecom facilities such as trunk exchanges and radio terminals, thus minimizing the cost of tails between the TMES and customer premises.

The ITERRA Business Services offered through the TMES allow customers to take advantage of the satellite's characteristics (distance-independence, broadcast capability, multi-access features) while reducing costs by sharing the use of the expensive earth stations with other customers.

ITERRA Dedicated Services (Figure 3)

Telecom also has on order a number of earth stations for ITERRA Dedicated Services. As the name implies, such earth stations will be dedicated to particular customers, and in fact in most cases will be located on customer premises.

The earth stations are of two types, one based on 64 kpbs "building blocks"and the other on 2 Mbps. As with the TMES, the digital building block approach allows a variety of speeds and services to be provided.

The sorts of customers interested in ITERRA Dedicated Services fall into one (or both) of two categories. First there are those for whom the satellite's chief attraction is simply that it is not terrestrial. The maximum network reliability is seen as being provided by redundant and completely separate technologies. Dedicated earth stations on customer premises result in the elimination of terrestrial tails in the satellite link, and some customers also feel more secure in having the greatest possible portion of the link under their direct control.

The second category of customers includes those who need satellite service in areas where a TMES is not available, for example in a regional town or remote mining site. If the customer's requirements are only for voice and low-speed data, the ITERRA Network Service may be an option, but if 9600bps or higher speed data is needed, an ITERRA Dedicated Service may be the only choice.

The ITERRA Dedicated Services have another distinguishing feature from the customer's viewpoint. With the Network and Business Services, the customer chooses from a range of standard service offerings. The Dedicated Services, in contrast, are essentially custom - designed. This allows not only a wider choice of data rates for example, but also such options as availability and performance specifications tailored to particular needs rather than to CCITT standards.

Application Examples

Remote Area Mining

Mineral development in Australia as elsewhere usually proceeds in three phases: exploration, construction and production. In the exploration phase, a team of geologists will examine several sites, spending a few days or weeks at each site before moving on to the next. At each site there is a need for voice communications with the company headquarters, and there is a need for some data communications to assess core samples, analyze seismic readings, etc. The transportable version of the ITERRA Network Service earth station is very attractive for this phase. The construction phase, in which equipment and infrastructure (roads, buildings, etc.) are installed, usually represents the peak of the manpower and communications requirements of a mining site. With conventional facilities, the result is insufficient communications capacity during this phase, excess capacity during the next phase, or both. The use of transportable earth stations again offers a

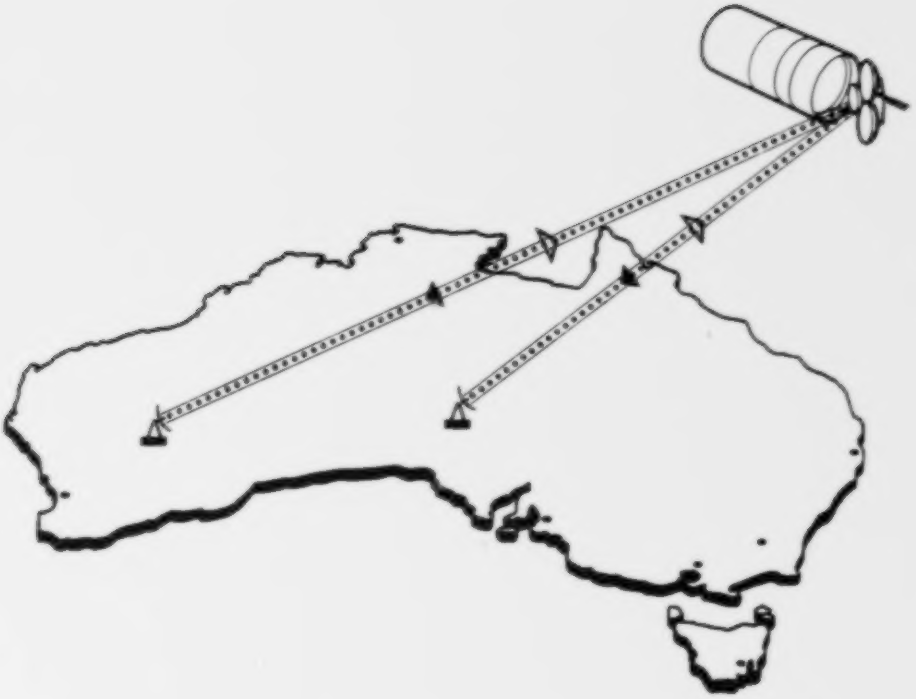

Fig.3 ITERRA Dedicated Services

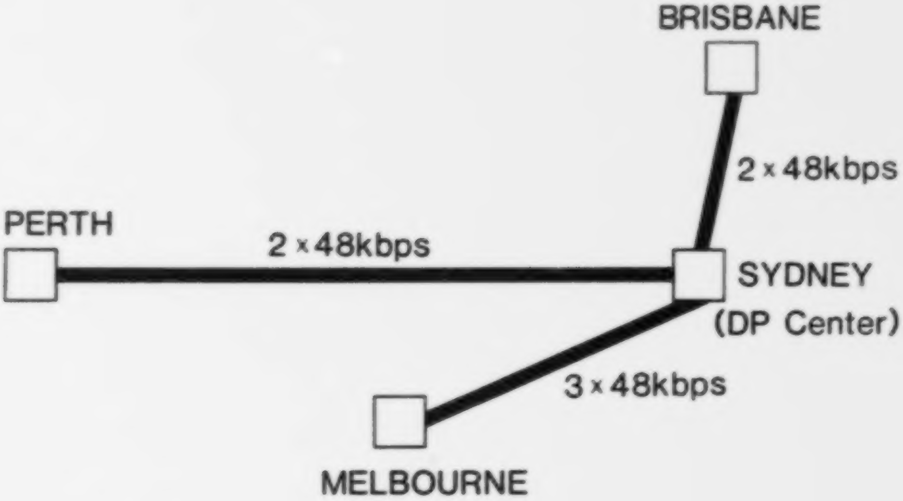
BRISBANE
2 × 48kbps
PERTH
2 × 48kbps
SYDNEY
(DP Center)
3 × 48kbps
MELBOURNE

Fig. 4 Typical Data Network

possible solution to this problem. Even with fixed earth stations, the problem is less severe with the satellite than with terrestrial facilities because of the third satellite advantage, the ability to use its capacity elsewhere when not needed for the original application.

In the production phase, the site is well-established and the communications requirements relatively static. In many cases a permanent terrestrial link will provide the most economic service. However for mines in extremely remote areas an ITERRA Network Service or ITERRA Dedicated Service will sometimes be the only feasible way to get a reasonable standard of service at a reasonable cost.

High Speed Data Distribution

There are a few applications in Australia for what is essentially a data broadcast service at 2 Mbps.

In all cases this originates in a major city (Brisbane, Sydney, or Melbourne for example) and is to be transmitted to other capital cities and large regional centers. With the development of the terrestrial network, 2 Mbps links between all major cities are becoming more numerous and more economical. For networks with only one or two receiving sites, then, digital microwave radio and optic fibre terrestrial links will be the preferred technology. With more then three or four receiving sites, however, the satellite's broadcast advantage becomes significant and an ITERRA Business Service (for capital cities) or ITERRA Dedicated Service (for country towns) begins to look attractive.

Network Reliability Enhancement

It is possible to use the TMES as part of the security provisions in a private network, and in fact a few of Telecom's customers are planning to do so. However, the maximum use of the satellite as a network backup is made with ITERRA Dedicated Service on-site earth stations.

Consider the customer network shown in Figure 4. The customer wants to protect the links in this star configuration data network. Note that the customer has other communications needs as well - voice tie lines, some videoconferencing - but the protection is only considered vital for the data. This is typical of, for example, a large bank.

The "brute-force" protection technique would be to duplicate the data network, once with terrestrial facilities, and again with satellite. However this would neither be very economic nor take advantage of satellite characteristics, in particular the flexibility and multi-access features. The recommended technique, shown in Figure 5, results from the following:

- First, the customer makes a judgement as to the minimum data requirements for each leg of the star.

- In consultation with Telecom, the customer next estimates the minimum total data capacity required of the backup network. If the customer agrees that it is very unlikely that more than one leg of the terrestrial star network will be faulty at any given time, the minimum requirement for the total will be the same as that of the largest leg of the star.

- A backup ITERRA Dedicated Service is provided, with that satellite capacity.
- Taking advantage of the satellite's flexibility, the satellite capacity is normally used for voice tie lines.

- If required to replace a faulty terrestrial link, the satellite capacity is switched to that link, and the voice traffic is diverted to the switched public network.

- Taking advantage of the satellite's multi-access capability, the satellite capacity can be switched to any of the links, thus providing full protection as long as no more than one terrestrial link is faulty at once.

Future Developments

Based on overseas experience, it is likely that a variety of new services, not now available or even contemplated, will be introduced. The number of TMES will probably increase as ITERRA Business Services are made available to more locations. The initial ITERRA services and facilities will provide a base from which to expand and develop these new offerings. Telecom Australia, through its International Consulting Group, will be offering to other Administrations the benefits of its experience in planning and developing ITERRA services.

Acknowledgement

I thank the Chief General Manager, Telecom Australia, for permission to publish this paper.

Reference

1. "The Australian Satellite System - Present and Future Plans", by Dr W. L. Nowland, PTC '85

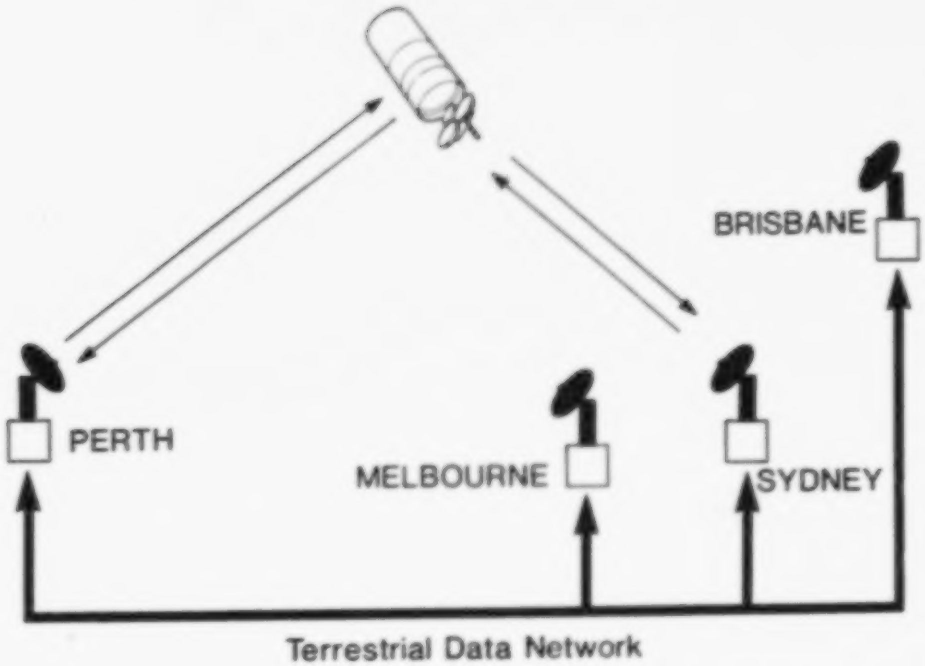
BRISBANE
PERTH
MELBOURNE
SYDNEY
Terrestrial Data Network

Fig. 5 Network Reliability Enhancement

Future Developments and Policy Analysis of the Emerging Two-Way Information Market

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1. Abstract

New developments in telecommunications technology have set the stage for a new society — the Information Society. The purpose of this study is to serve as a guide to the formulation of regulatory policy with regard to the two-way information services market over the next decade. The forces shaping this market are evaluated with respect to social goals and objectives for economic efficiency. If the public policy questions raised by this promising technology are addressed, its benefits will be fully realized.

2. INTRODUCTION

New developments in telecommunications technology have set the stage for a new society -- the information society. But together with the new technologies comes a danger of intensifying existing inequalities between the "information haves" and "information have-nots." The purpose of this study is to serve as a guide to the formulation of regulatory policy with regard to the hard-wired information services market. We believe that if the public policy questions raised by this technology are carefully considered, its potential will be fully realized.

This paper proceeds through three stages in its analysis of the impacts of the growing market for videotex and teletext services. The first stage, a market analysis, forecasts U.S. trends and investigates the forces acting on the distribution market for these new technologies. The second stage is an analysis of impacts associated with videotex and teletext from the perspectives of both the business providers of these services, and the social goals of a democratic society. Freedom of speech, for example, is addressed through the analysis of freedom of access to the electronic media and the price of access to creators of content. The third stage, based on issues developed in the second stage, identifies policy options, and concludes with recommendations for policies addressing videotex and teletext.

3. MARKET ANALYSIS

The communications industry is viewed as one of the leading high-growth industries for the rest of the 20th century. Its potential to realize significant revenues has led to a number of optimistic visions about future services and their anticipated market penetration. The purpose of this section is to portray the essence of this growth in the U.S., and provide an overview of this developing market through the next decade.

3.1 BACKGROUND

The market penetrations for teletext and videotex services are couched in uncertainty and probably reflect the bias of high expectations, since the estimates are often provided by the potential marketers of the system. It appears that initial growth rates will be slow, and widescale use will await the 21st century.

Full channel teletext offered via Direct Broadcast Satellites (DBS) technology would make large amounts of information available because of its high data transmission rate, but would still involve a relatively low cost. An initial investment of $250 for receiving the signal and monthly fees on the order of $10 for a descrambler and $14-$18 for use of the service are all that would be required.

For standard broadcast teletext, which is delivered during the channel's vertical blinking interval (VBI), the information retrieval speed would be lower and information availability much less, but the cost would be lower as well. For such service the only requirement would be a teletext receiver built into the TV, which would increase the price of the set approximately 20%. Its current market penetration in the U.S. is about one percent.

The penetration of videotex services is expected to grow at a faster rate than the one for teletext, especially in the U.S. The advantage of videotex over teletext is its ability to offer a vast selection of information to the customer interactively. In this system, the user will need some type of personal computer with a modem or a dedicated videotex terminal to communicate with the suppliers of information. The delivery system for videotex could be via either telephone or cable TV. The predominant mode was expected to be cable TV only a few years ago. Today telephone based videotex systems are the predominant choice.

Estimates on the market for telephone-driven videotex are about seven percent of the U.S. households, or approximately six million subscribers by 1990 [1]. The prediction of penetration for videotex services is estimated at ten to twenty million households by the year 2000 [2]. Today there are approximately 600,000 subscribers to all kinds of interactive data base services.

3.2 DEMAND FOR TWO-WAY SERVICES

A demand assessment can be logically divided into two markets: business and residential; this analysis will address the residential market. It is anticipated that the principal services which will be offered are: information retrival, home shopping, ticketing services, local classified advertisements, electronic banking, video games, home security and text services. Cablevision published the results of one of one of its surveys on consumer demand and the results are shown in Table 1 [3].

Anticipated household expenditures for videotex or teletext information services in the U.S. is on the order of \$20/month for subscription and transport service; \$40/month for subscription, transport and terminal. The estimated revenues from videotex are currently under \$100 million per year but are expected to grow to several billion by the year 2000. These revenues are for content services alone. The potential revenues in these markets and the impact on the existing delivery of entertainment and shopping information, has resulted in involvement from AT&T, IBM, Citicorp, RCA, CBS, Sears, Xerox, Times-Mirror, and other broadcasting and publishing companies. Additional service sectors to be added to the list are banks, retail and mail order companies.

The uncertainty over the market shares for videotex, along with uncertainty about the distribution mechanisms for newspapers and other information services, creates an environment where diversification and joint venturing are necessary to ensure future survival. The role of standards in the emerging videotex and teletext technologies may also influence concentration in the industry. This will be particularly true in countries where standards are not defined. Finally, the marketplace survival of a particular technology will be linked to the attractiveness of the services being offered via the hardware. As a result, one can expect to see joint ventures between content creators and commercial distribution systems.

Based upon our market analysis, we foresee a strong and steadily growing market for hard-wired information services, tempered in some areas by strong competition from emerging satellite technologies. In addition, in the entertainment field, transmission media will face competition from videodisks and, particularly, videocassettes. We foresee the hard-wired information services industry being characterized by large, diversified corporations giving the supply side of the market an oligopolistic structure.

Let's summarize the reasoning behind this conclusion. The research and development base which is necessary to compete in a high-technology field, along with the scales of production necessary to satisfy a large market, give a natural advantage to large companies. The high capital and manpower costs of installing a physical connection network require considerable financial resources. The low return on capital investment expected during the early years of service make deep corporate pockets necessary to stay in long enough to reap the significant revenues occurring further downstream. Last, smaller companies may not have the credibility needed to bargain against larger corporations for exclusive contracts with companies providing services related to shopping. Hence, a competitive multitude of suppliers cannot be expected. On the other hand, a monopolistic structure for the industry is also unlikely. Competition among the major players positioning themselves to enter these markets is likely to be intense and we expect no clear winner.

In summary, we foresee the emerging home telecommunications market being dominated by a relatively few companies which have hard-wired distribution systems and which provide content in joint ventures with particular content providers. Forces tending to promote concentration in the market are the uncertainty about consumer demand, and high entrance costs into the market. In this new market, consumers will have the opportunity to become more selective in their use of information and selection of entertainment. This should have important implications for specalized programming, as a pay-by-program system will allow consumers to express their willingness to pay.

4. DIVERSITY OF INFORMATION: A SOCIAL GOAL

Freedom of access to the electronic media has been chosen as a key goal out of the belief that there is a close relationship between the social goal of diversity of expression and ease of access to the media for individuals. What are the major forces shaping this key issue? There are two opposing forces acting on the media. A force facilitating diversity of information appears to be the number of channels made available by the emerging two-way technology. This force creates the condition necessary for ease of access. The other force is evident in the growing concentration of the media in the hands of a few large special interest groups.

The influence diagram (Figure 1) depicts the major variables that affect the goal of freedom of expression. As illustrated, the ultimate goal of freedom of expression is determined both by the degree of freedom of access to an information distribution system and by the economic incentive to create information. Freedom of access without adequate financial incentives to create alternative content will not necessarily increase the diversity of information available.

At first glance, it seems that the large number of channels induced by new technologies such as teletex, DBS, etc. provide the viewer with considerable choice of information and programming. The price structure of the one-way broadcasting industry however, provides strong economic incentives for mass audience programs to the detriment of smaller audiences who prefer more specialized kinds of information. These economics are acceptable for the entertainment industry and for large-content providers. However, for those whose talents and interests are oriented more toward creation of programs for specialized audiences, the risks involved constitute an effective barrier to entry.

As the new two-way electronic means of communications becomes available, stronger economic incentives to create diverse content will exist. The emerging two-way broadband hard-wired technology will not only facilitate access to the media by providing a lot of channels, but it will also create the conditions under which diverse content will be produced and will grow. A content creator will have an incentive to create messages aimed at small audiences since new services, such as pay-by-program, will allow audiences to express their willingness to pay.

4.1 ECONOMICS OF INFORMATION

What is the economic argument supporting our

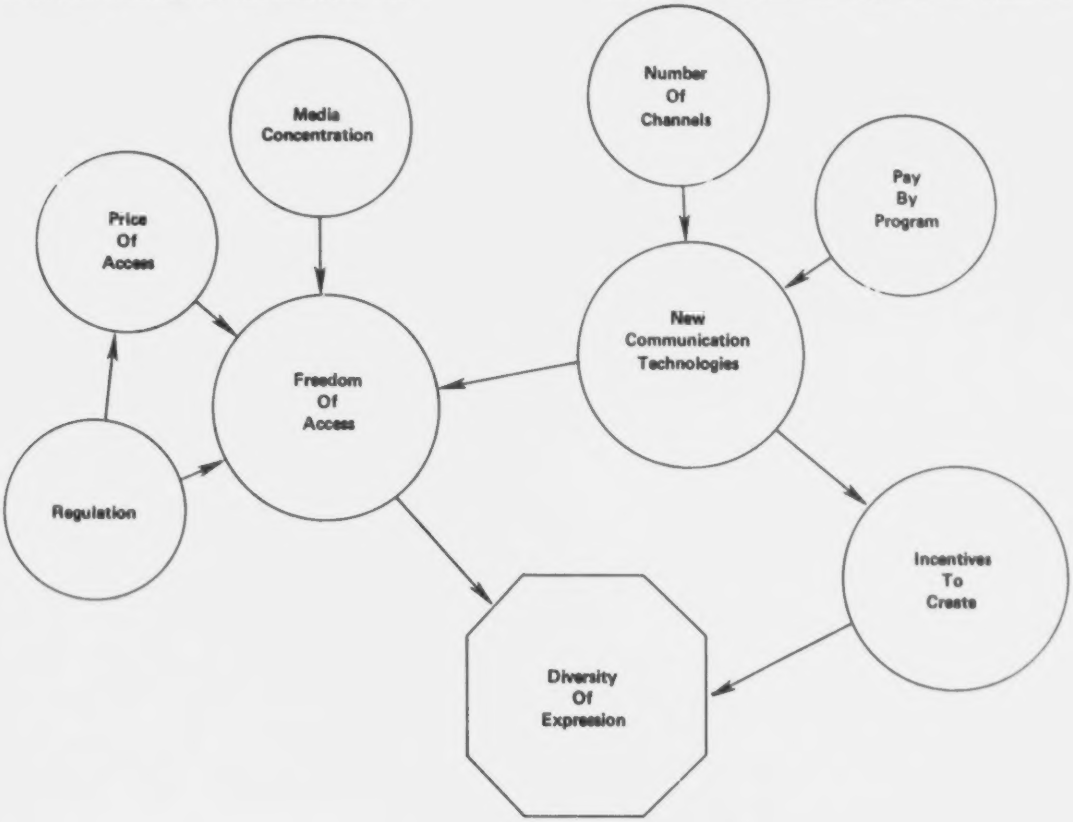

FIGURE 1

INFLUENCES ON FREEDOM OF EXPRESSION

optimism? Mass communication media, like radio and TV, treat their content like a public economic good. Since the most efficient marginal price for such content is close to zero, there is no user-proportional reward available to the creator. As a result, information on price, which conveys individual preferences of consumers to the producer, is denied. The creation and development of information is left to the judgment of experts. Many kinds of content are underproduced, and the content created is primarily directed to mass audiences.

A videotex system can provide its content as a private economic good. The system is able to provide records of the usage and can provide individual bills for the users as well as detailed revenue reports for the creators of content. No broadcast system can do that. The content of a broadcast system is constrained by its technology to behave as a public good. Two systems, one videotex and the other teletext, could offer precisely the same kind of content, but one could offer it as a private good, the other only as a public good. Hence, it is the vehicle, not the content, that determines the economic behavior of the content.

How should a creator of content set the price for a product when the costs of duplication and distribution are negligible? When first placed into a two-way information system, the content is worth only the time the author spent on creating it. At some point, the content will have a value that has been determined by the market. The author needs to receive help in "product" pricing from the system that does the distribution. Starting with an author-suggested price per use, a videotex system could adjust that price in a way that maximizes the returns while capturing some percentage of the demand. This strategy of evaluation and pricing would require detailed usage data from the information system -- data that can only be provided by a distribution system capable of supporting content as a private economic good.

Obviously, freedom of access to the media does not mean access to zero price. At nonzero price, however, some information will not gain access. It is of interest to examine which type of messages will be excluded by a nonzero price, and determine whether there is a systematic bias in the range of content available to the public. One type of message that will be excluded is a message valued by the public at less than its cost of creation and distribution. From an economic viewpoint this type of message should not be produced. The second type of message, however, is valued at more than its cost, but because of noncompetitive access and distribution prices, cannot be communicated. Such a message is likely to be the one aimed at small audiences or at audiences with limited ability to pay. Systematic exclusion of this information from the media represents a limitation on such groups' ability to receive information.

A clear understanding of how a society generates wealth by moving information is essential to economic growth. The ability of videotex to process data about how content is used and to convert it into publicly and commercially useful information on how to price content, could well be the most important contribution of the emerging technology in the information age.

5. POLICY OPTIONS AND RECOMMENDATIONS

While the benefits of two-way information services appear to be evident, this new technology may further separate the educated segment of the society ("information haves") from the segment that does not have the means or the know-how to exploit the benefits of the new technology ("information have-nots"). A number of questions are raised by such a possibility. Should some government agency, via the taxpayer, subsidize certain hardware and programming for specialized audiences? Should public libraries be diverting funds from the purchase of books to the purchase of videodisplay terminals and data base subscriptions? In addition, the ability of collecting detailed records on individuals' data base usage may raise the concern of violations of subscribers' privacy.

The objective of the following section is to provide a guide for governments dealing with the emerging information market. Rather than make detailed policy recommendations, the frameworks for three policies were developed. The rationale is that analysis of the issues indicated more potential than actual problems. In the short term, government should allow the industries (cable TV and telephone) to compete in order to develop the most efficient distribution systems. In order to encourage diversity, non-discriminatory access should be required to a segment of each delivery system. Also, a mechanism for subsidizing creation and distribution costs is suggested. It should be recognized that most of the analysis is oriented towards identifying problems which are likely to emerge. In that the problems are probable, rather than actual, recommendations should be viewed as potential policies to be held in abeyance, and as an indicator to the industry of the likely direction of regulatory policy.

5.1 CRITERIA

Following is a set of criteria used in developing the final policy recommendation:

1. Minimize government intervention and let the market allocate resources.

2. Use government laws to shape the direction of the markets, but not to create government-run industries.

3. Promote the decentralization of power using

general constraints, to protect political and social rights.

4. Promote an informed society which is knowledgeable about different perspectives towards political issues and diverse cultural and artistic resources.

5. Allow freedom of access to the influential formats for distributing information.

6. Establish privacy guidelines to protect subscribers from unauthorized use of their data base usage information.

5.2 RECOMMENDATIONS

The following recommendations were developed to provide the conceptual framework for a public policy. The need for these policies will be determined by the industry and the consumers who will establish the structure of the emerging videotex and teletext market.

1. POLICY: NON-DISCRIMINATORY ACCESS

   Promote non-discriminatory access to videotex data base systems. The user has to pay the market price to access the data base. With regard to teletext, require a channel(s) for non-discriminatory access.

2. POLICY: SUBSIDIZE COST OF CREATION AND ACCESS

   Provide tax incentives for videotex and teletext system operators to diversify their sources of news reporting, wire services, commentators and independent columnists. This idea may introduce some inefficiencies and enforcement problems. However, an incentive for diversifying the content of videotex and teletext systems, with respect to news reporting, is an important step.

3. POLICY: NON-REGULATION OF INDUSTRY

   It is recommended that governments not respond to industry pressures to segment the information services market. If a natural monopoly emerges in the home information services market in the long term, due to joint-use economies, it should not be legislated away. Regulate the monopoly, if it emerges, according to the other policy recommendations.

   It is clear that most of these ideals cannot be fully realized by law or government intervention alone. We believe they can be best achieved if the motivations of those involved in the communications market consider the public interest as an integral part of the decision-making process.

ACKNOWLEDGEMENT

The author wishes to acknowledge the instrumental contribution of Phil Ralph to this paper and the valuable assistance of Samuel Berkman to its review.

FOOTNOTES

[1] Broadcasting, October 12, 1981

[2] Tydeman, Lipinski, Adler, Nyham, and Zwinpfer, Teletext and Videotex in the United States, Institute For the Future (IFF) Menlo Park, VA March 1982

[3] Quoted from Cablevision, IFF, 5-4, P. 5-3

Table 1: CONSUMER DEMAND FOR TWO-WAY SERVICES

	Percent Responding	
Service	Very Interested	Somewhat Interested
Fire/burglar alarm	49	32
Shopping information	35	35
News/weather/sports	26	39
Meter reading	26	29
Home banking	23	29
Ticket reservations	18	25
Travel reservations	17	25
Opinion polls	16	28
Travel schedules	15	30
Financial news	10	22

Enhancement of Japan's International Data Communications

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Abstract

International data communication networks based on a packet-switching technology have been expanding throughout the world. Together with circuit-switched data networks, they will undoubtedly form the backbone of the global telecommunication network in addition to existing telephone and telex networks. These data communication networks will be further enhanced by advanced technologies such as network interworking and Message Handling System. They will satisfy the various needs of the public by incorporating sophisticated terminals.

1. Introduction

The establishment of the International Standards on Packet-Switching Networks (X.75, X.25, X.28) by the CCITT during the 1977-80 study period have encouraged the construction of Packet-Switched Data Networks in many countries. Ultimately, they will become the backbone in global public data telecommunications, in addition to the present telephone and telex networks.

Approximately 70 packet switched networks in 43 countries have been introduced. They are widely being used as public networks, in response to new telecommunications demands.

KDD, Japan's international telecommunications carrier, has started an international data transfer service, VENUS-P in April 1982. It is based on a packet-switching technology and follows the CCITT international standards. It is now connected to 34 countries.

The circuit-switched data network is also recognized as a useful means for transmitting large volumes of data such as facsimile and data file transfer. These two networks - packet-switched and circuit-switched - will undoubtedly complement each other in the future, forming the backbone of tomorrow's international data communications.

The standardization of the interworking between different types of public networks is deemed one of the main questions in CCITT for the 1985-88 study period. By interconnecting with each other and with conventional networks such as telephone and telex, data communications networks will increase their usefulness.

A series of recommendations concerning MHS (Message Handling Systems), which were approved by the 8th Plenary Assembly of the CCITT in 1984, have also been attracting attention as a means of enhancing networks to meet increasingly diversified service needs. International data communications will undoubtedly keep on growing with these technologies.

2. International Data Communications Environment

2.1 Market Expansion

Along with business activities becoming more extensive, the volume of information handled in offices is increasing enormously. Office automation (OA) systems are being progressively introduced in many firms. Word processors and personal computers are becoming popular in business offices. Because this trend is encouraging communications among office terminals, data communication facilities for OA systems have become an important part of business communications.

Parallel with this, international business activities are rapidly growing. For example, a number of Japanese firms are expanding their foreign branch offices, and foreign companies are extending their activities to Japan. Consequently, a great increase in international telecommunications traffic is being observed.

With the deregulation of telecommunications in the U.S., the U.K. and Japan, a number of domestic VAN (Value Added Network) carriers have come into existence in those countries. Requirements for connecting their networks to those in other countries have emerged. This also is a factor stimulating the expansion of the international data communications market.

2.2 Advances in Technology

Progress in digital technologies to encourage the construction of digital telecommunication networks with various additional facilities is being intently pursued in many countries.

It is recognized that ISDN could be the ideal network in the future. However, in this century, digital data networks will play the dominant role in non-voice communication service such as data and image transfer.

Furthermore, the progress of LSI (Large Scale Integrated) circuit technologies has made it possible economically for terminals having various advanced functions to meet the diversified needs of users to come into the market.

In order to communicate between such advanced terminals, a lot of activities have been intensively carried out by CCITT, ISO and other organizations to set up international standards.

These technological advances will enable networks and terminals to adapt more readily to increasingly diversified data communications needs.

3. Japan's "Backbone" International Data Communication Networks

3.1 Packet-Switched Public Data Networks

VENUS-P, an international public data transfer service based on packet-switching technologies and conforming to the CCITT International Standards, commenced operations in April 1982.

This service transfers data at speeds of 100 to 9,600 bps. It is widely used for communications between a computer and data terminals (information retrieval from data bases, mailbox access, etc.), and for communications among computers. Tramsmission quality is quite high (bit error rate is on the order of 10^{-10}). Communication between data traminals that operate at different speeds is also available.

There are three types of accesses to VENUS-P:

1) direct connection by installing subscriber lines to the VENUS-P switch (X.25, X.28)

2) connection to the VENUS-P switch via NTT's DDX-P packet-switched network

3) connection to the VENUS-P switch via the public telephone network (X.28)

Around 5,000 terminals have subscribed to VENUS-P. Approximately 95% of these terminals are connected through the PSTN (Public Switched Telephone Network).

Presently, when subscribers are connected to VENUS-P through the PSTN, they can set up connection only from an asynchronous X.28 terminal (300 or 1,200 bps) to overseas countries. For future extension of services, however, VENUS-P will support reception through the PSTN by X.28 terminals of transmissions from overseas countries. It will also support access by X.32 packet terminals through the PSTN. This will enable packet terminals such as teletex to access VENUS-P over the PSTN. The extended services will start in April 1986.

For handling large volume data transfers such as facsimile, the switching equipment of VENUS-P is scheduled to be upgraded to support a long-size packet such as 1,024 Octets.

There are at present 34 service areas, as shown in Fig.1. Connections to the U.S., the U.K., the Federal Republic of Germany, France and Singapore are made by direct links at 9,600 bps, using X.75 protocol. Connections to other service areas are by transit links via foreign carriers.

In the 7th (1980) Plenary Assembly of the CCITT, international standards were approved for terminal/network interfaces, network/network interfaces and an international numbering plan. Now that the necessary elements for building a global data communications network are in place, many countries have been constructing packet-switched networks in order to meet new telecommunications demands. As a result, there are currently about 70 networks in 43 countries. Packet-switched networks have been introduced in nearly all of the world's high data traffic countries, making it now possible to offer worldwide public data transfer services.

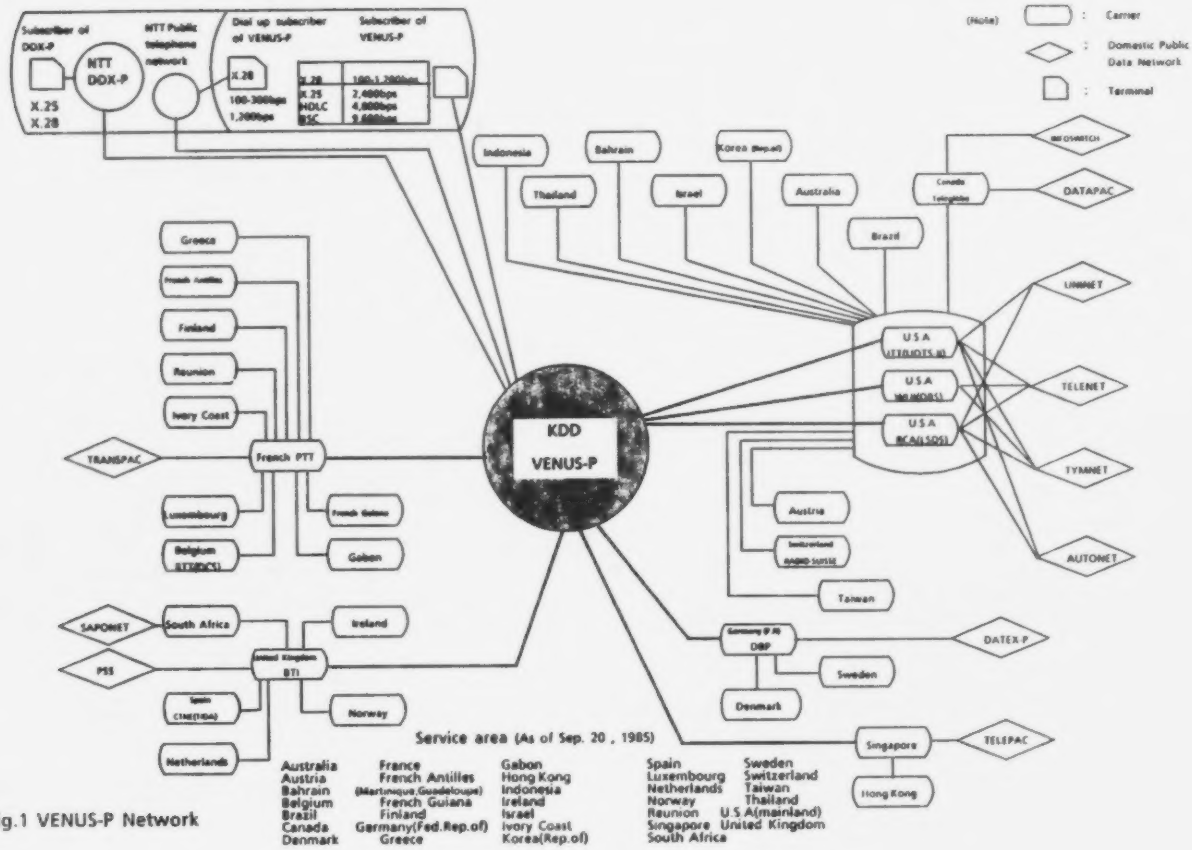
Moreover, the construction of packet-switched data networks is expected to go on expanding, eventually including developing counries.

3.2 Circuit-Switched Public Data Networks

With the progress of communications technology and data processing techniques, there is an increasing need for international public data transfer services based on circuit-switching. This method is well-suited to the exchange or transfer of large volumes of information such as facsimile and file transfer.

Packet-switching involves sophisticated processing by the storage of data and its conversion to packets. In contrast, circuit-switching may be regarded as a simple extension of the switching system used in conventional public networks such as those for telephone and telex. Therefore it has fewer limitations on its communications protocol. Due to their different fields of application, the two types of networks are to be mutually complementary "backbone" networks in public data communications.

Recognizing that a high proportion of the international telephone traffic from and to Japan is facsimile, KDD plans to introduce VENUS-C, an international public circuit-switched data transfer service, in September 1987. This will


Subscriber of DDX-P
NTT DDX-P
X.25
X.28
NTT Public telephone network
Dial up subscriber of VENUS-P
X.28
100-300bps
1,200bps
Subscriber of VENUS-P
X.28 100-1,200bps
X.25 2,400bps
HDLC 4,800bps
BSC 9,600bps
(Note)
: Carrier
: Domestic Public Data Network
: Terminal
Indonesia
Bahrain
Korea (Rep.of)
Thailand
Israel
Australia
Brazil
Canada Teleglobe
INFOSWITCH
DATAPAC
UNINET
TELENET
TYMNET
AUTONET
USA ITT(UDTS-I)
USA WUI(DBS)
USA RCA(LSDS)
Greece
French Antilles
Finland
Reunion
Ivory Coast
TRANSPAC
French PTT
Luxembourg
Belgium RTT(DCS)
French Guiana
Gabon
KDD
VENUS-P
Austria
Switzerland RADIO SUISSE
Taiwan
Germany (F.R)
DBP
DATEX-P
Sweden
Denmark
SAPONET
South Africa
Ireland
PSS
United Kingdom
BTI
Spain CTNE(TIDA)
Norway
Netherlands
Singapore
TELEPAC
Hong Kong

Service area (As of Sep. 20, 1985)

Australia
Austria
Bahrain
Belgium
Brazil
Canada
Denmark
France
French Antilles
(Martinique,Guadeloupe)
French Guiana
Finland
Germany(Fed.Rep.of)
Greece
Gabon
Hong Kong
Indonesia
Ireland
Israel
Ivory Coast
Korea(Rep.of)
Spain
Luxembourg
Netherlands
Norway
Reunion
Singapore
South Africa
Sweden
Switzerland
Taiwan
Thailand
U.S.A(mainland)
United Kingdom

Fig.1 VENUS-P Network

satisfy the new demands for high-speed, high-density digital facsimile and teletex working with the circuit-switched public data networks in North America and European countries. User interfaces are X.21 and X.21bis. Speeds will range from 2,400 to 9,600 bps at the beginning. For the international interface, X.71 will be used.

In recent years, ISDN has been the subject of lively discussion, both at home and abroad. It ultimately aims at the digitization of telephone networks, the integration of various services and the provision of global services. The construction of a full-scale ISDN for international communications will probably require a long period of time and great expense. So, it seems as though it will be implemented stage by stage.

In this context, we believe the construction of circuit-switched digital data networks is the first stage of ISDN.

4. Enhancement of International "Backbone" Data Communications Networks

4.1 Intreconnecting Different Networks

Interconnections between different networks are necessary for greater access to data communications networks from such conventional public networks as telephone and telex, and for connecting packet-switched and circuit-switched data networks. Such interconnections will increase the value of individual independent networks and most likely promote more extensive use of them.

The 8th Plenary Assembly of the CCITT approved Recommendation X.300 regarding general principles for network interworking in public data transfer services. Many questions on the intreconnection of different networks have been set up for the 1985-88 CCITT study period.

As stated above, VENUS-P can already be accessed via the public telephone network from X.28 asynchronous terminals. As for teletex, which is to be introduced as a sophisticated form of telex, Recommendation F.200 encourages the expansion of its service areas to telex networks. Teletex/telex service interconnection is fully described in Recommendation F.201. These Recommendations were approved by the 8th Plenary Assembly of the CCITT. A teletex/telex conversion facility (C/F) is also regarded as a network interconnection system.

KDD has developed a prototype C/F system and has successfully tried an experimental connection between VENUS-P and an international telex network. KDD plans to introduce a commercial C/F to increase teletex and telex communication in early 1988.

Interworking Units are being developed to connect packet-switched and telephone networks, and to connect packet-switched and telex networks. They will be in service during 1986.

4.2 Enhancement of Switching Nodes

In the field of message communications, a demand is gradually emerging for international advanced message communication services that provide not only message switching, but also a variety of advanced functions via data transfer networks. These include media conversion functions to permit communications between different types of terminals; delivery check functions to permit one to know immediately whether the recipient has received a message; and mailbox functions to store messages in specified boxes within a network. In this regard, MHS has been receiving attention as an international standard technology capable of satisfying these demands.

Within the CCITT, SG VII has been studying the international standardization of MHS. The 8th Plenary Assembly adopted the X.400 series of Recommendations.

MHS is, in principle, able to deal with any messages in digital signal form, irrespective of content (character messages, facsimile, graphics, voice, etc.). In other words, it uses a common means of transferring information, independent of the medium. MHS also possesses functions regarded as vital to future international message communications such as message store and forward, delivery/non-delivery notification, media conversion and encryption. Together with international data communications networks, the MHS will make advanced international message communications services possible.

KDD has recently developed the world's first MHS based on the CCITT Recommendations. An international interconnection test to verify the X.400 series recommendations was performed from January to March of 1985, successfully linking with the EAN system of the University of British Columbia in Canada.

MHS technology is commercially introduced at first for dedicated systems that handle both character and facsimile messages. The first commercial system commenced operations at the end of 1985. Following this, MHS is expected to be introduced progressively into international dedicated message switching systems and public networks, with the aim of enhancing data communications services.

5. Development of New Services

5.1 Mailbox Services

The MHS technology mentioned above is being studied for use in supporting a mailbox function as one of its applications. In this system, the real time nature of communications is lost, but there is no need for the customer to fix the location of his terminal. This is especially significant in international communications where there is a time difference: he only accesses his box when he needs to. With facilities for message storage, he may benefit from such value-added functions as media conversion.

This service may be accessed from the telephone network, telex network and data networks. By using the message storage and conversion functions, internetworking functions even more advanced than those of an Interworking Unit can be realized. KDD is planning to offer Mailbox services based on MHS technology to X.28 asynchronous terminals and telex terminals in April 1986.

Mailbox has expanded rapidly in North America. Communications carriers in other countries are now starting to offer the service.

The present Mailbox systems are not built in accordance with international standards. However, when the CCITT Recommendations for MHS are adopted, newly constructed or replaced systems will make international interconnections according to X.400 series protocols.

It is expected that in several years, international MTA (Message Transfer Agent) networks will be constructed. The interconnections among international carriers' MTAs will provide the international extension of mailbox services. That is, the international connection of mailbox UAs (User Agents) will be established through such international gateway MTAs as shown in Fig.2. One of the impotant functions of the gateway MTA is to find a route to a destination UA by using the directory information.

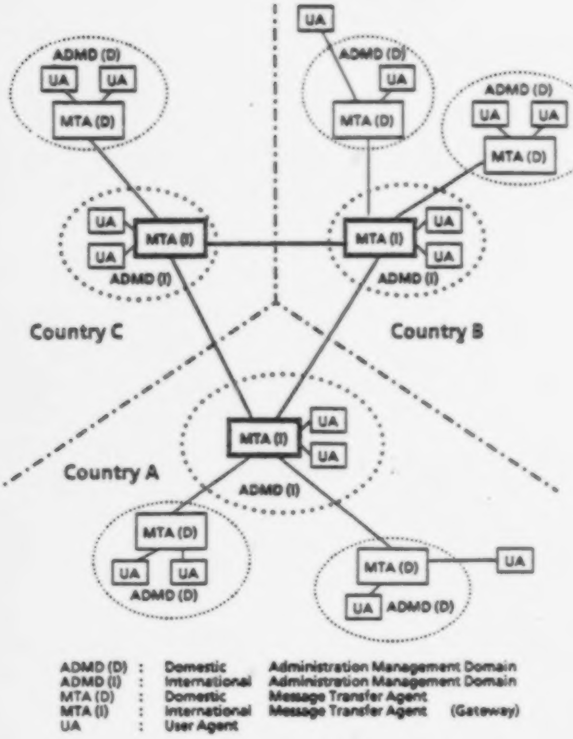

UA
ADMD (D)
UA
UA
MTA (D)
ADMD (D)
UA
UA
MTA (D)
UA
MTA (D)
UA
MTA (I)
UA
MTA (I)
UA
UA
ADMD (I)
UA
ADMD (I)
Country C
Country B
MTA (I)
UA
UA
Country A
ADMD (I)
MTA (D)
UA
UA
ADMD (D)
MTA (D)
UA
UA
ADMD (D)
ADMD (D) : Domestic Administration Management Domain
ADMD (I) : International Administration Management Domain
MTA (D) : Domestic Message Transfer Agent
MTA (I) : International Message Transfer Agent (Gateway)
UA : User Agent

Fig. 2 International MTAs network

5.2 International Public Facsimile Store and Forward Service over the Public Switched Telephone Network

It is observed that around 70% of ISD (International Subscriber Dialing) calls to high traffic countries are facsimile transmissions.

ISD users who send facsimile messages are now demanding additional facilities, such as delayed delivery of facsimile messages during off-peak hours when discount rates apply, and multi-destination delivery.

One measure taken by KDD to meet the increase in traffic demand of facsimile is to make use of telephone exchanges systems and international trunks as efficiently as possible by introducing message storage capabilities. The traffic handled during busy hours can thus be redistributed.

Therefore, KDD is now planning to introduce a facsimile message store and forward system that can be accessed by ISD users. The service is scheduled to commence around April 1987.

This system will be designed to use the MHS technologies described above, and designed to have enough storage capacity to hold messages for delayed delivery during off-peak hours even at midnight.

5.3 Teletex Services

Teletex, the service standardized by CCITT in 1980, is regarded as a version of telex that has more sophisticated functions. Texts for teletex service can be presented using combinations of more than 300 varieties of characters, and can be transferred at a speed of 2,400 bps.

According to the CCITT Recommendation, a public teletex communication system is defined as one that employs a CSPDN (Circuit Switched Public Data Network), a PSPDN (Packet Switched Public Data Network) and/or a PSTN (Public Switched Telephone Network) as its network.

During the first stage of the teletex era, teletex services using CSPDN were introduced in some countries such as the Federal Republic of Germany, and Scandinavian nations. International teletex services using CSPDN were available to users within those countries.

At present, more than 10 countries are providing international teletex services using CSPDN; some countries are providing those services using PSPDN and/or PSTN; and some other countries have plans to introduce international teletex services using an appropriate network within one or two years. Furthermore, an IWU (Inter-Working Unit) between a CSPDN and a PSPDN enables teletex terminals connected to different kinds of networks to communicate with each other; a Teletex/Telex conversion facility (CF) enables teletex terminals to communicate with telex terminals.

KDD has developed a teletex terminal technology for use with PSPDN, and a Teletex/Telex conversion facility (C/F) to permit communications between teletex and telex terminals. An experimental international teletex service started in April 1, 1985 which is scheduled to run for a period of about two years. Full-scale services will be provided subsequently, in such a way as to match trends in other countries and trends in demand.

5.4 Videotex Services

Videotex, a new image communications service, is already being tested or commercialized in Japan, the U.K., Canada, the U.S., France and the Federal Republic of Germany. Each country has a different system. Three schemes were recommended equally by the CCITT: CAPTAIN (the Japanese system), NAPLPS (the North American system) and CEPT. The possibility of introducing international Videotex services, including the interconnection of the different systems is being studied in KDD.

6. Conclusion

The international packet-switched data transfer service, VENUS-P, is being offered in response to demands for international data communications services. In the future, the capacity of this network will be increased to cope with the anticipated rapid growth in traffic and expansion of overseas service areas.

An international public data transfer service based on circuit-switching is scheduled to be offered to meet needs for diversification of use, higher traffic and higher speed volume. These two services -- packet-switched and circuit-switched services -- will constitute the basic media in international data communications.

The enhancement of VENUS-P, the installation of circuit-switched public data networks, the introduction of the advanced functions of MHS technology, and together with the advancement of peripheral technologies such as interworking units and new terminals will make it possible to meet the growing demands for diversified international data communications services.

INTELSAT'S PLANS FOR THE PACIFIC REGION

Joseph N. Pelton and Rafael A. Lemus
INTELSAT

ABSTRACT

Today's complex telecommunications needs demand urgent solutions. This is particularly so in the Pacific -- the world's fastest growing economic region. This paper addresses INTELSAT's plans to meet the communications needs of the Pacific.

INTELSAT's plans for the future integrate three major elements to meet the Pacific's diverse and dynamic needs. These three key elements are: new satelite facilities; smaller, lower-cost earth stations; and exciting new services and assistance programs, including Project SHARE, the INTELSAT Development Fund, the INTELSAT Assistance and Development Program, VISTA, INTELSAT Business Service (IBS), INTELNET I and II, and new international video networks. These new INTELSAT facilities and services will provide service innovation, user-responsive flexibility, and viable and cost-effective alternatives to fiber optic cable facilities.

1. INTRODUCTION

INTELSAT serves the world. To this end, it has 16 of the latest technology satellites, strategically located around the world. Up to six of the satellites can be "seen" by the countries of the Asia/Pacific Region. There are more than 280 earth stations (128 facing the Pacific Ocean Region satellites and 154 facing the Indian Ocean Region satellites) that carry both domestic and international traffic in the Asia/Pacific Region, with the potential for direct linkage to more than 350 international earth stations, and another 450 earth stations operating in domestic networks in 26 countries. Moreover, INTELSAT satellites can now reach 174 countries and territories. These satellites are available to serve the needs of the world, as well as of the Pacific Ocean countries, day and night, 365 days a year.

Our facilities serve as "information multipliers." Satellite facilities do what conventional land-based communications cannot do; namely create interactions and flexible networks. INTELSAT's earth stations can interconnect the most remote parts of the world in the blink of an eye. These services are also becoming cheaper, more reliable and more accessible through the use of ever smaller antennas and new satellites embodying the very latest in aerospace technology. Thus, the age of information is now becoming a reality, for countries of the Pacific, via INTELSAT satellites.

2. NEW INITIATIVES IN THE PACIFIC OCEAN REGION

During the past two decades, INTELSAT has tried to meet quickly, effectively and responsively every requirement presented by its users. We continuously review and update our service offerings and introduce new, innovative offerings to meet the needs of every nation and user, with over 100 new services introduced in the last two years.

This process has given birth to many new features in the INTELSAT system -- features that represent the response of INTELSAT to the challenges of the information age and the twenty-first century; features that make our world grow smaller and bring technological advances, not just to some, but to every corner of the globe; features that range from higher-powered C-Band spot beam transponders to new, incredibly small, umbrella size earth stations; features such as creative programs and projects that will bring satellite services where they are needed most, providing telecommunications services that are less expensive, faster and more effective than ever. Key innovations include: implementations of Project SHARE, new dimensions of the VISTA program, INTELNET II, the INTELSAT Development Program (IDF), new INTELSAT Business Services, and a new transponder sales policy.

PROJECT SHARE

Project SHARE, a program that allows free use of INTELSAT's global facilities (from available spare capacity), to promote tests and practical demonstrations in the fields of health care and education for rural and remote areas, is now solidly under way. This program is growing and continuously expanding to extend new services to remote and rural areas -- many of them in the Pacific Ocean Region. Today, there are close to 30 projects in various stages of planning and implementation, involving some 37 different countries, and inquiries are received daily.

The Ministry of Post and Telecommunications of the People's Republic of China has already successfully finished, in October 1985, the first phase of a two-phase Project SHARE activity. The project involves broadcasts of advanced, university-level lectures to regional university campuses. The second phase will include additional programming provided internationally from the United States, Canada, United Kingdom, and other countries. The benefits of these satellite and terrestrial broadcast lectures already reach more than 500,000 students, and this number is expected to grow into the millions. The ultimate system will be designed to also upgrade the training of China's ten-million teachers. The People's Republic of China's new network (already expanded from 45 to 53 earth station sites) can now reach 326 of the 370 cities and prefectures in China. This network thus covers over 70 percent of the entire country, including remote areas that never before had access to television broadcasts. (See Figure 1.)

Project SHARE's activity in Indonesia will provide educational exchange between the Bandung Institute of Technology and the National Technological University in Colorado, New York State University, and the Open University in London, England. The faculty and students will benefit from lectures, three hours long, twice a week, on such topics as computer sciences and engineering, control systems, microelectronic, biotechnology and highway engineering. These "refresher" courses will bring faculty and graduate students up-to-date with new developments in their specialized fields. Follow-on analysis and evaluations will be conducted to determine whether or not a long-term educational exchange via satellite is a feasible option for the Bandung Institute of Technology. This project is of particular interest because it will be using NEC-donated slow-scan video links. Thus, the complete network, involving Pacific Ocean and Indian Ocean satellites, will use a total of only six voice-equivalent circuits, making this network possible at a cost a hundred times less than full-motion video links. Other Asia/Pacific Ocean Region projects under planning at this time include national television universities for Colombia and Peru; United States-to-India educational exchanges; and educational exchanges between China, the United States and Canada.

Project SHARE is, of course, INTELSAT's newest assistance program, but we are also improving our existing programs as well.

INTELSAT ASSISTANCE AND DEVELOPMENT PROGRAM (IADP), THE INTELSAT DEVELOPMENT FUND (IDF) AND VOLUME PURCHASE OF VISTA EARTH STATIONS

Since 1978 the IADP program has provided technical and operational assistance in all aspects of INTELSAT satellite planning. So far, we have provided assistance to 95 countries INTELSAT has provided this assistance through 118 different projects and 15 seminars, with many of these involving Asia and the Pacific Basin countries. Some on-going and completed IADP projects in the Asia/Pacific Region include assistance in planning of VISTA service, earth station upgrades for dual polarization, implementation of TDMA/DSI, earth station training programs at technical training establishments, help with earth station specifications and procurement, and providing seminars on INTELSAT and its services.

Through IADP, INTELSAT has provided assistance to the South Pacific by preparing materials for the South Pacific Training Centre in Fiji. We have assisted Nauru in expanding its Standard B earth station facility. In the Solomon Islands, IADP has helped in planning and implementing a small domestic lease system between the islands. Currently, INTELSAT is helping UNESCO to plan, demonstrate, and implement an INTELNET network in the Asia/Pacific Region for scientific and technical exchange that will be called ASTINFONET. A similar project under Project SHARE is being explored with the UN University to combat the so-called "brain drain" problem.

But as good as IADP has been, we are trying to improve it. INTELSAT has recently extended the IADP program to include the INTELSAT Development Fund (IDF). The IDF is a program designed to help developing countries carry out financial viability studies, and apply for and receive financing for their particular telecommunications needs. The IDF program can be used to provide advice and assistance in conducting financial and economic viability studies, preparing specifications for ground segment

TVRO Stations Under Project Share

(PEOPLE'S REPUBLIC OF CHINA)

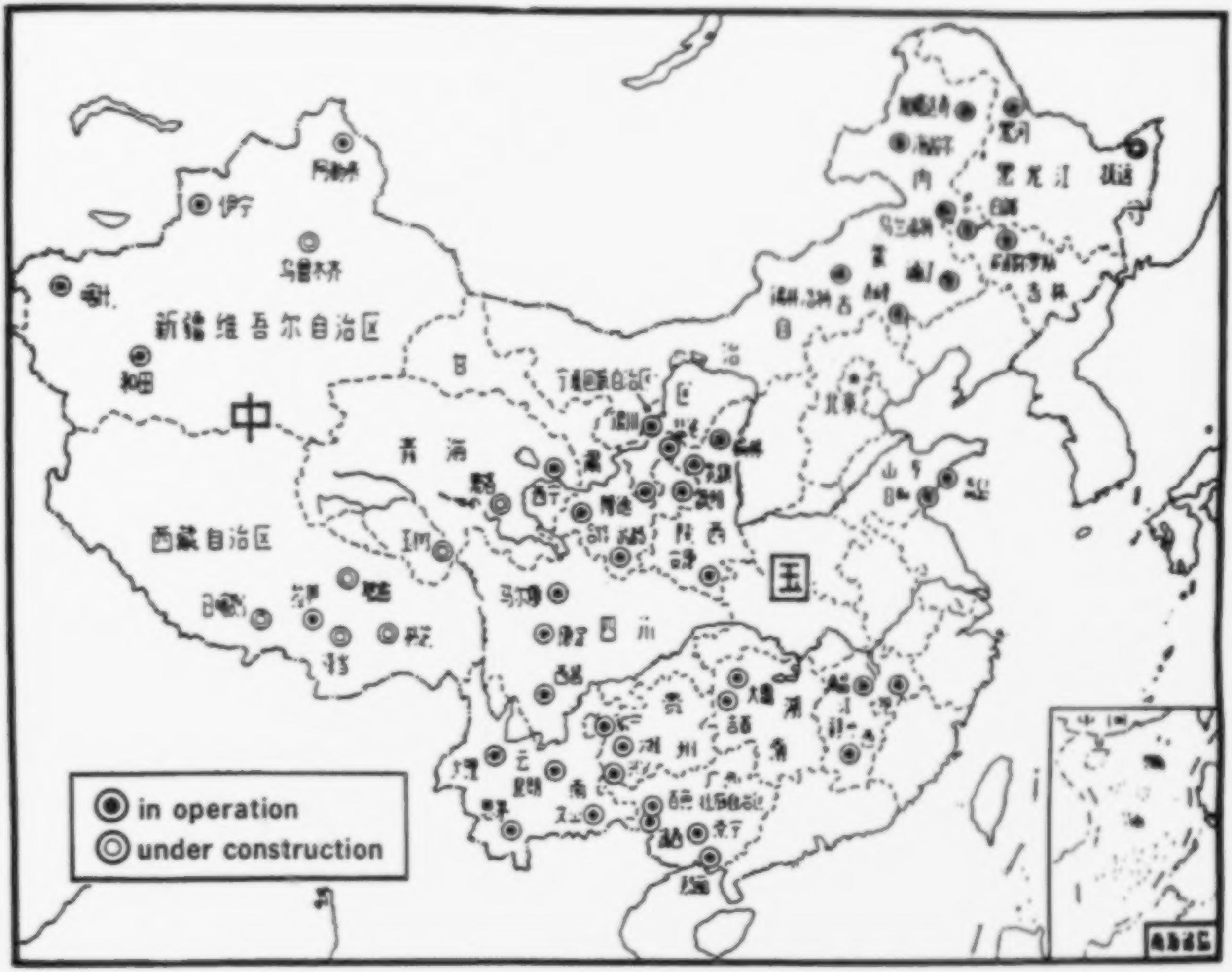

新疆维吾尔自治区
西藏自治区
青海
中
国
四川
黑龙江
吉林
● in operation
◎ under construction

FIGURE 1

and terrestrial interface equipment, helping to locate funds for capital financing, preparing documents and providing other support for loan or grant applications and loan negotiations, and organizing billing and collection processes.

Through the IDF program, financing assistance is made possible to help countries meet their telecommunications needs, and acquire the necessary equipment (such as VISTA terminals) which would not have been possible otherwise. Most recently, INTELSAT has initiated planning with regard to a scheme whereby VISTA (D-1) terminals (4.5 meters in size) could be acquired on a volume discount basis, with INTELSAT acting as purchasing agent. The possibility is also being explored that payments for these earth stations, as acquired "at cost" from INTELSAT, could be paid for out of "capital return" payments made to INTELSAT Signatories. Final approval of this volume-purchase plan for VISTA terminals is expected shortly, with the view to a program being initiated in 1986.

Under this new program, it is hoped that Tuvalu and Niue, plus six islands in Fiji, will be equipped with new VISTA terminals. These locations, now so isolated from the rest of the world, we hope will be able to link into the INTELSAT network by year-end 1986. These new links could be used to provide not only regular communications but also emerging health and medical services, cyclone warnings and education.

PLANNED DOMESTIC SERVICES

INTELSAT has offered spare transponders for domestic services since 1975. This option has given every nation the opportunity to plan, install and exploit their own national telecommunication networks using INTELSAT's satellites if they so choose -- and some 27 countries have, in fact, done so. But, very soon, INTELSAT will expand the features of these domestic networks by the provision of several degrees of protection categories for the potential restoration of domestic or regional satellites. Most revolutionary is INTELSAT's new policy of "selling" excess capacity for countries desiring domestic capacity. Up to 150 transponders, generally ranging in cost from $3 million to $5.5 million, will be sold on a first-come, first-served basis to both developed and developing countries, to meet domestic requirements. The same capacity will also be available for lease on a preemptible, or on a "planned" non-preemptible basis as well. Many countries of the Asia/Pacific Region -- almost ten in number -- have expressed interest in such capacity for domestic services, or possible restoration of existing or planned domestic satellite systems.

This new domestic sales and lease policy is expected to generate a total of some $65 to $70 million in revenues for INTELSAT in the next few years. More importantly, it represents a major impetus in the ready availability of satellite capacity for domestic services. With INTELSAT's 16-satellite network, and capacity available in both the C and Ku-Bands in low, medium, and high power transponders, these domestic applications can range from highly sophisticated digital networks and cable television distribution networks, to rural communications systems for remote areas of developing countries. In short, this policy represents a major extension of the INTELSAT global satellite revolution to include dozens of countries wishing to expand their domestic, as well as their international capabilities.

3. INTELSAT'S SPACE SEGMENT FACILITIES IN THE PACIFIC REGION

INTELSAT serves the countries in the Pacific with satellites located in both the Pacific and the Indian Ocean Regions. In 1986, a milestone year for INTELSAT in the Pacific Region, all the satellites deployed will be of the INTELSAT V series. With the advent of the new INTELSAT V spacecraft, there will be greater capacity, and new C-spot beam and Ku-spot beam coverages to support domestic, regional and international requirements. These state-of-the-art INTELSAT V satellites will enhance the flexibility of the wide variety of INTELSAT offerings, since they have transponders capable of new coverages, as well as a wider choice of beam connectivities.

The new spacecraft flexibility, together with INTELSAT's innovative and purposeful thrust toward small and low-cost earth stations, is opening the door to a full spectrum of services and options that will untap the enormous potential of satellite communications. Moreover, this technological breakthrough will be creatively exploited by INTELSAT, with innovative financial packages, attractive applications geared toward education and health, and an array of new and highly user-oriented options for the implementation of national telecommunications networks. Indeed, the only limitation will be the imagination.

The five INTELSAT V satellites providing services to the region are located at orbital positions of 57°E, 60°E, 63°E, 174°E and 180°E. Further, in 1986 the 66°E slot will also be available, and an INTELSAT V spacecraft will be positioned there to increase the coverage and capacity in the Asia/Pacific Region. In the Appendix hereto, there is a detailed technical description of the characteristics for both the C-Band (6/4 GHz) and Ku-Band (14/11 GHz) transponders in the INTELSAT V spacecraft. Further, Figures 2, 3, 4 and 5 offer examples of typical hemispheric and spot beam coverage patterns for INTELSAT V satellites.

4. INTELSAT'S SERVICE OFFERINGS

INTELSAT's third element in the plan for the Pacific Region hinges on a vast variety of services, tailored to capitalize on the technological advantages of INTELSAT V spacecraft, and designed to work with a wide range of earth stations represented by 13 different standards. These earth stations range in size from 0.8 meters up to 32.5 meters, and can access international, regional, or domestic networks, carrying every conceivable type of traffic (including telephony, data, telex, video, facsimile, etc.)

These INTELSAT services include a wide variety of offerings for voice, data, video, and domestic applications. Some services have been designed for business applications, and some others for thin-route (rural) applications. In particular, development of the VISTA service was tailored to include, as a major element, the needs of the Pacific Islands for thin-route rural communications applications. The mandatory performance characteristics of the VISTA terminals were relaxed and modified to accommodate simpler and more cost-effective technical specifications. Moreover, while analog modulation is currently used in the VISTA service, the development of digital VISTA is well under way. This development will try to capitalize on proven digital technology, and thus help to reduce the earth stations' costs.

In addition, INTELSAT's rates for all its services are already low, and we have plans that will allow us to continue the trend. Indeed, INTELSAT's basic telephony rates have been reduced 12 times since 1965. These reductions, when adjusted for inflation, have cut INTELSAT's rates down to 5 percent of what INTELSAT charged 20 years ago.

INTELSAT's services are defined by six major factors:

1. Type of Traffic Carried. The range of traffic keeps expanding and now includes: telephone, data, telex, facsimile, broadcast television, videoconferencing, voice mail, audio, stereo audio, cable television distribution, and combined video/voice/data.

2. Type of Modulation and Access Techniques. This identifies the specific communications technique used to carry the signal of interest and how multiple access is achieved. INTELSAT uses both analog and digital methods for multiple access. They include both fixed and demand assigned Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), and Code Division Multiple Access (CDMA). The latter method is also known as "Spread Spectrum."

3. Earth Station Types. INTELSAT has developed standards for earth stations -- a total of 13 different types. These standards guarantee a high service quality throughout the globe, and also lead to volume production, which allows economies of scale.

4. Frequency Bands. These bands include the C-Band (6/4 GHz) and the Ku-Band (14/11 or 14/12 GHz). Also, L-Band (1.5/1.4 GHZ) capacity is leased to the INMARSAT system.

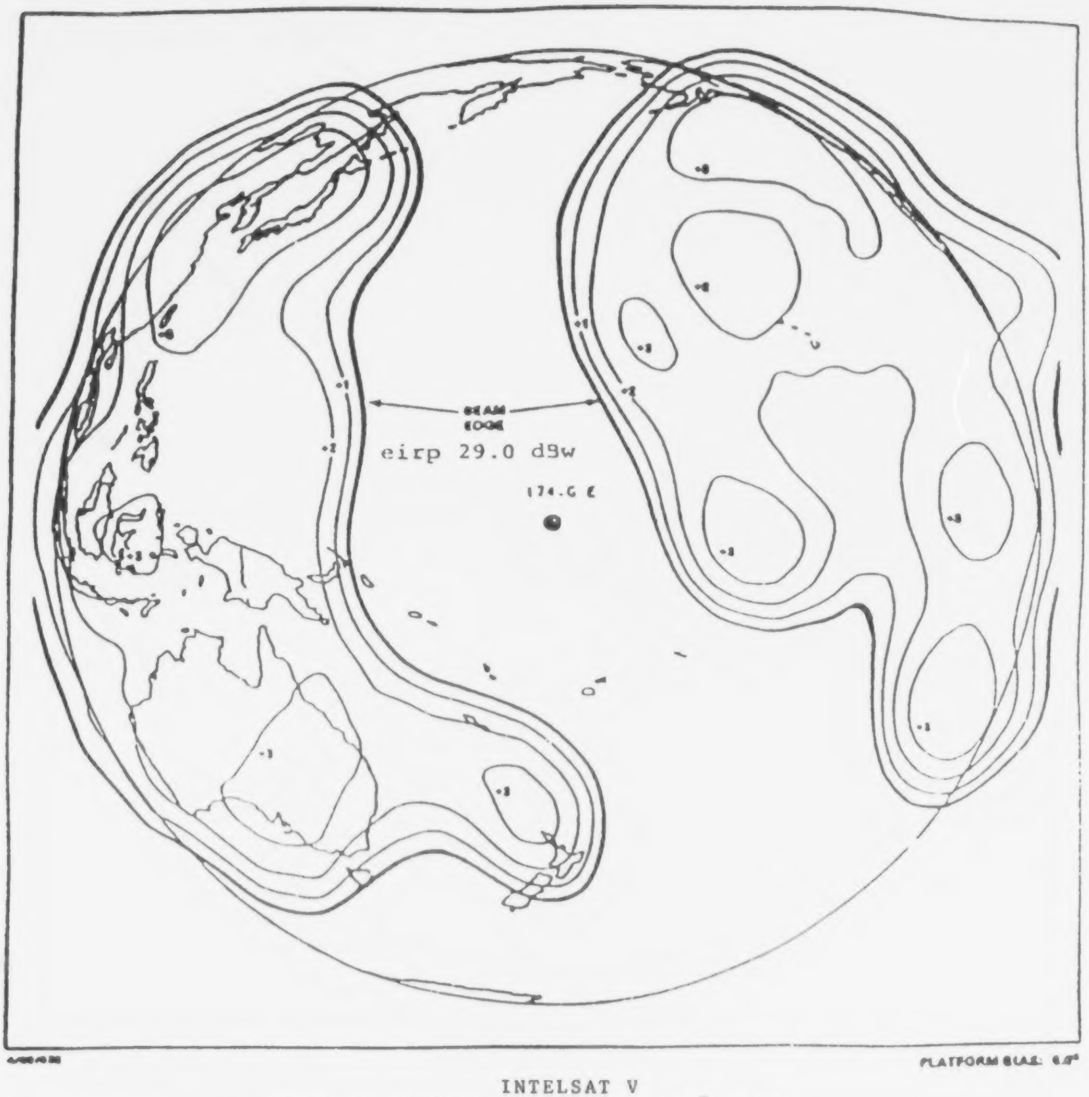
5. Level of Protection. Services may be subject to preemption. However, INTELSAT also offers non-preemptible services, with several degrees of protection to fit most needs.

6. Periods of Availability. This identifies the time period in which the service is available. For example, long-term and short-term leases, as well as offerings on a part-time and occasional-use basis, or on a peak or off-peak period.

Along these lines, Table 2, in the Appendix, shows the different voice services. These services use both analog and digital modulation techniques, as well as frequency and time-division-multiple-access of the INTELSAT spacecraft. Further, they are provided in the Ku-Band and in the C-Band, together with appropriate earth station types. The thin-route telephony service (VISTA) uses, in addition to a small type of earth station (D-1 with a size of 4.5 to 5.5 meters), a very effective form of companded frequency modulation.

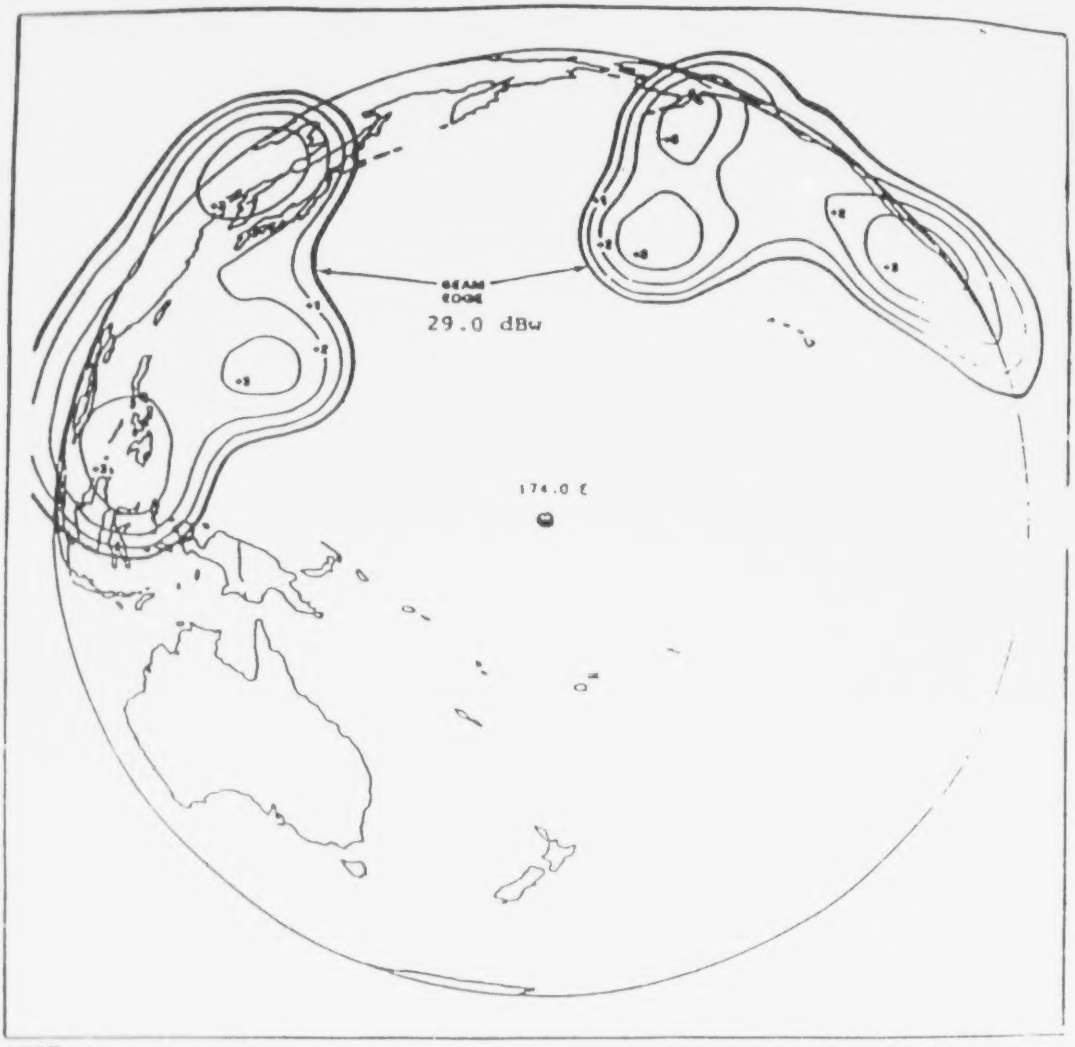
INTELSAT is leading the way towards the introduction of an Integrated Services Digital Network (ISDN), and to this end,

FIGURE 2


BEAM
EDGE
eirp 29.0 dBw
174.0 E
PLATFORM BIAS:

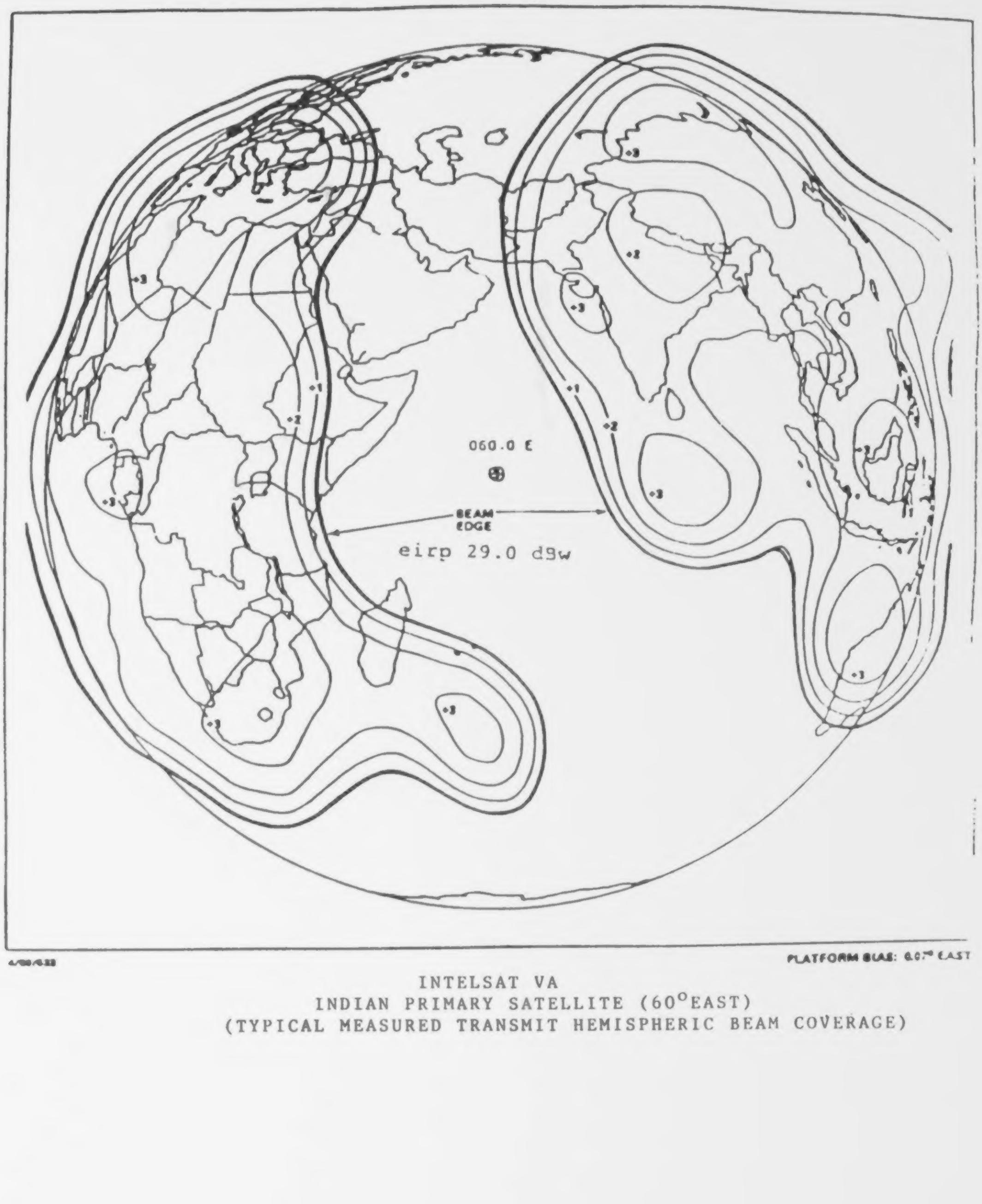
INTELSAT V
PACIFIC PRIMARY SATELLITE (174° EAST)
(TYPICAL MEASURED TRANSMIT HEMISPHERIC BEAM COVERAGE)

FIGURE 3


BEAM EDGE
29.0 dBw
174.0 E
PLATFORM BIAS 0.5°

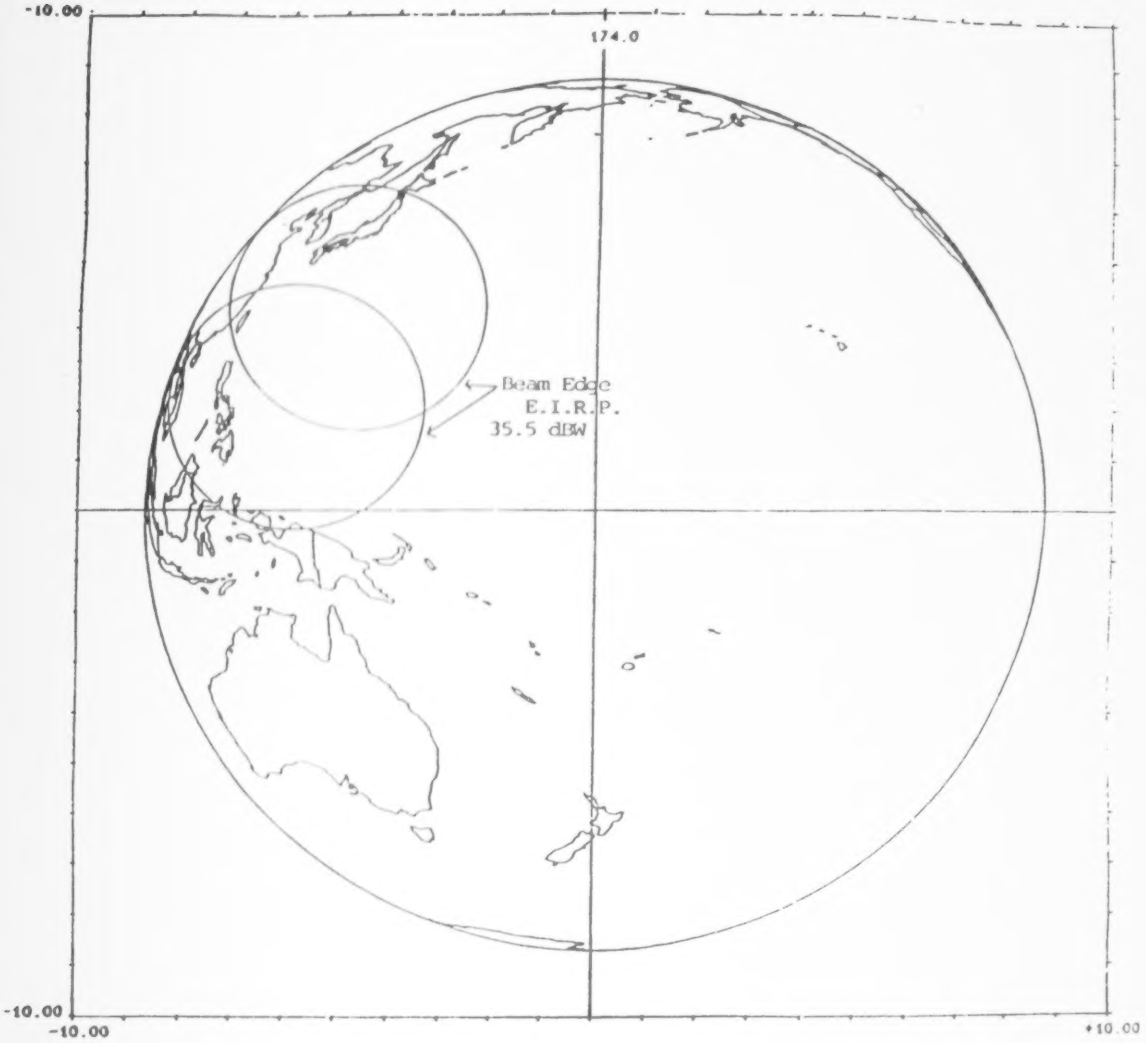
INTELSAT V
PACIFIC PRIMARY SATELLITE (174°EAST)
(TYPICAL MEASURED TRANSMIT ZONE BEAM COVERAGE)

FIGURE 4


060.0 E
BEAM EDGE
eirp 29.0 dBw
+3
+2
+1
PLATFORM BIAS: 0.07° EAST

INTELSAT VA
INDIAN PRIMARY SATELLITE (60^{o}EAST)
(TYPICAL MEASURED TRANSMIT HEMISPHERIC BEAM COVERAGE)

FIGURE 5


-10.00
174.0
Beam Edge
E.I.R.P.
35.5 dBW
-10.00
-10.00
+10.00

INTELSAT VA
PACIFIC PRIMARY SATELLITE (174° EAST)
TYPICAL SPOT C-BAND COVERAGE

there is a vast array of INTELSAT data service offerings. Table 3 shows the offerings available. These include INTELSAT Business Services (IBS), INTELNET, TDMA/DNI, and PSK data channels.

IBS is a wholly digital service that allows the use of a large number of small, low-cost earth stations located near end-user's premises. It can carry any type of non-public-switched digital traffic (voice, facsimile, data, video teleconferencing, etc.). This service offers a full range of capacities -- from a single 64 Kbps channel up to a full 72 MHz Ku-Band transponder. Further, the earth stations carrying the service can be as small as 3.5 meters in diameter, for use in the Ku-Band, and 5.0 meters in diameter, for use in the C-Band.

The rate that INTELSAT charges its Signatories/users for a full-time 64 kilobit/second IBS channel per month varies from $500 (U.S.) to $312.50 (U.S.). (These rates depend upon the number of channels that are leased. Rates that Signatories charge final users, within a country, are somewhat higher.) Moreover, there are rate adjustment factors that reflect the various options available, such as connectivity, coverage, and earth station size.

INTELNET is also a wholly digital service, with the additional advantage that it can use even smaller earth stations. The size of the earth stations can be as small as 0.8 meters in diameter. INTELNET service is designed to transmit and receive all types of data to and from umbrella-size earth stations. Its advantages can be fully exploited in data collection and dissemination activities, like financial networks, remote printing of newspapers, etc.

The service is offered on both the Ku-Band, as well as on the C-Band, and on a fractional or full-transponder basis. The fraction of a transponder that can be leased may be as small as 1 MHz in the Ku-Band and 9 MHz in the C-Band. INTELSAT is also exploring the possibility of offering smaller bandwidths in the C-Band. Due to the large volume of small earth stations that an INTELNET network requires, economies of scale have been achieved and the price of an earth station has been lowered to approximately $3,000 (U.S.). This low cost also reflects the very effective digital modulation technique that is employed in this service offering. INTELNET uses spread spectrum and also BPSK, with one-half Forward Error Correction (FEC) coding.

The remaining two data services -- PSK data channels and Time Division Multiple Access/Digital Non-speech-Interpolation (TDMA/DNI) -- are designed to carry the major trunk traffic data requirements of a country. As such, the services are offered on a full-time basis and carried through large earth stations -- Standards A, B, or C. Studies are under way at this time to reduce the size and performance characteristics of these standards in the future and possibly to authorize more types of services (both analog and digital) through smaller earth stations, such as the Standard E and F series.

Satellites are extremely cost effective for the exchange of television programs at the national, regional, or global levels. Table 4 shows INTELSAT's video service offerings and their corresponding characteristics. The magnitude of video services provided by INTELSAT for full-time (long-term lease), part-time and occasional-use is impressive. Moreover, INTELSAT offers not only analog video, but also digital television on both the C and Ku-Bands, and the ultimate flexibility of cross-strapping the frequency bands for uplink in the C-Band and downlink in the Ku-Band, or vice versa. Additionally, INTELSAT also offers an integrated package that carries video/data/voice, providing a flexible and attractive package for videoconferencing applications.

INTELSAT also leases full and fractional transponder capacity to meet the full range of domestic satellite telecommunications needs of any country. In a single transponder INTELSAT accommodates several types of traffic, ranging from video to voice and data, as well as customized service applications. Currently, there are 26 countries -- ranging alphabetically from Algeria to Zaire -- that are leasing INTELSAT space segment to satisfy their varied national needs in the areas of telephony, data, facsimile, television, etc. Table 5 shows the major characteristics of INTELSAT's domestic services.

Furthermore, due to the importance of domestic networks, INTELSAT offers various degrees of protection for the restoration of non-preemptible domestic services. Moreover, INTELSAT is giving due consideration to providing this service on a planned basis to accommodate the requirements of several nations, as compared to today's provision of domestic services on a sparecapacity basis. This type of offering, together with attractive customer features, will also allow the option to purchase a transponder to implement a satellite-based domestic telecommunications network, taking immediate advantage of transponder ownership, as well as benefitting from the operational and technical expertise of INTELSAT.

5. CONCLUSION

The needs and demands in the area of telecommunications can only be effectively satisfied if proper attention is given to the overall planning of facilities. To ease this task, INTELSAT offers a comprehensive approach that relies on three major and essential elements -- space segment resources, adequate service offerings, and new and innovative approaches to enhance the value and the quality of satellite telecommunications in the region.

INTELSAT is determined to offer to the Pacific Region countries the best of satellite facilities. A broad discussion about INTELSAT's commitment to this region has covered a detailed description of the satellite resources to be available, the wide array of services offered, and an insight into the new initiatives that will multiply and introduce wider availability of satellite services, smaller earth stations for rural and thin-route applications, and special financial arrangements for acquisition of VISTA terminals. With this plan, INTELSAT expects to satisfy, in an effective and timely manner, the telecommunications needs of many nations in the Pacific Region, and the world.

APPENDIX

INTELSAT V FEATURES

INTELSAT V satellites feature four-fold frequency reuse in the C-Band (6/4 GHz), and carry two spot beams in the Ku-Band (14/11 GHz), to provide a capacity of up to 12,000 voice circuits and two TV channels simultaneously. Additionally, a switching matrix in the satellite facilitates extensive interconnectivity between the various transponders, including cross-strapping between the Ku-Band spot beams and the C-Band hemi-zone beams. The antenna subsystem includes antennas for global coverage, hemi-coverage, zone coverage, and spot coverage in the C-Band and ground command steerable east and west spot antennas in the Ku-Band. Typical coverage patterns of these antennas are shown in Figures 2, 3, 4 and 5. The characteristics of the corresponding INTELSAT earth stations can be found in Table 6.

TABLE 1

TRANSPONDER CHARACTERISTICS
INTELSAT V SPACECRAFT

Transmit EIRP (dBw) at Beam Edge and Receive
System Sensitivity G/T (dB/K) at Beam Edge

Transponder type	Specified G/T (dB/K)	Specified eirp (dBw)
C-Band:		
Spot (72 MHz)	-16.0	35.5
West Hemi (72 MHz)	- 9.0	29.0
East Hemi (36 MHz)	- 9.0	26.0
Zone (72 MHz)	- 6.0	29.0
Global (36 MHz)	-16.0	23.5
Ku-Band:		
West spot (77 MHz)	3.3	44.4
East spot (77 MHz)	0.0	41.1

TABLE 2

VOICE SERVICES

Characteristics of INTELSAT Services

Service category	Service Identification	Type of traffic carried	Modulation	Earth Stations (Typical)*	Band	Preemptibility/ Protection	Availability
VOICE							
	Conventional Telephony	Voice, Telex Facsimile	FDM/FDMA and CFM/FDMA	A,B, and C	C and Ku	Non-Preemptible, Fully Protected	Full time
	Digital SCPC	Voice	SCPC/PCM/PSK	A,B, and C	C and Ku	Non-Preemptible, Fully Protected	Full time
	Demand Assigned SPADE	Voice	SCPC/PCM/PSK DAMA	A and B	C	Non-Preemptible, Fully Protected	Full time
	Thin Route Telephony VISTA	Voice, Telex and Data	SCPC/CFM	D1,D2, A,B	C	Non-Preemptible, Fully Protected. Preemptible also available	Full time
	Time Division Multiple Access/DSI	Voice	QPSK/PCM/ TDMA	A,B, and C	C and Ku	Non-Preemptible, Fully Protected	Full time

* Earth station characteristics can be found in Table 6.

TABLE 3

DATA SERVICES

Characteristics of INTELSAT Services

Service category	Service Identification	Type of traffic carried	Modulation	Earth Stations (Typical)*	Band	Preemptibility/ Protection	Availability
DATA	PSK data channels(IDR)	Data	SCPC/PSK or multichannel per carrier	A,B, and C	C and Ku	Non-Preemptible, Fully Protected	Full time
	Time Division Multiple Access DNI	Data	QPSK/TDMA/ DNI	A,B, and C	C and Ku	Non-Preemptible, Fully Protected	Full time
	INTELSAT Business Service (IBS)	Non public switched digital services voice, telex,etc	QPSK/FDMA uses SCPC or Multichannel per carrier can use TDMA on a case by case basis	A,B,C,E-1,E-2, E-3,F-1,F-2,F-3	C and Ku	Non-Preemptible, Fully Protected	Full time Part-time Occassional use
	INTELNET	Data	Spread Spectrum (CDMA). Also BPSK/FDMA	Standard G	C and Ku	Non-Preemptible, Fully Protected Preemptible also available	Full time Occassional use

* Earth station characteristics can be found in Table 6.

TABLE 4

CHARACTERISTICS OF INTELSAT'S VIDEO SERVICES

Service Category	Service Identification	Type of Traffic Carried	Modulation	Earth Stations * (Typical)	Band	Preemptibility/ Protection	Availability
VIDEO	International leased T.V.	Video, non-public switched voice	Analog/FDMA	A, B and C	C and Ku	Non-preemptible, various degrees of protection. Preemptible also available.	Long-term lease Short-term lease Occasional
	International Video	Video, non-public switched voice	Analog/FDMA	According to transmission plan approved by INTELSAT	C and Ku	Non-preemptible, various degrees of protection. Preemptible also available	Long-term lease Part-time Occasional
	Improved Video	Video, non-public switched voice	Three 24MHz carriers per transponder	According to transmission plan approved by INTELSAT	C and Ku	Preemptible only available	Long-term lease Occasional
	Digital T.V.	Video	Digital/FDMA	According to transmission plan approved by INTELSAT	C and Ku	Non-preemptible Fully protected Preemptible also available	Long-term lease Occasional
	Integrated Video/ data/and non-public switched voice	Video, voice, data	Analog/FDMA	According to transmission plan approved by INTELSAT	C and Ku	Non-preemptible Fully protected Preemptible also available	Long-term lease
	Cross-strapped Video	Video, non-public switched voice	Analog/FDMA	According to transmission plan approved by INTELSAT	C and Ku Cross-strapped	Preemptible only available	Long-term lease

*Earth Station Characteristics Can Be Found in Table 6

TABLE 5

DOMESTIC SERVICES

Characteristics of INTELSAT Services

Service category	Service Identification	Type of traffic carried	Modulation	Earth Stations (Typical)*	Band	Preemptibility/ Protection	Availability
DOMESTIC	Domestic Leases	Video, Voice, Data Facsimile, etc.	As appropriate	Standard Z	C and Ku	Non-Preemptible, Various degrees of protection Preemptible also available	Long-term lease Short-term lease

* Earth station characteristics can be found in Table 6.

TABLE 6

INTELSAT STANDARD EARTH STATIONS

Standard* Name	Minimum G/T dB/°K	Band (GHz)	Services	Size in meters
A	40.7	6/4	All	26.0-32.5
B	31.7	6/4	All	10.0-13.0
C	39.0	14/11 14/12	All	14.0-20.0
D-1	22.7	6/4	VISTA	4.5- 5.5
D-2	31.7			10.0-13.0
E-1	25.0	14/11 14/12	IBS	3.5- 4.5
E-2	29.0			5.5- 6.5
E-3	34.0		IBS, INTELNET	8.0-10.0
F-1	22.7	6/4	IBS	4.5- 5.5
F-2	27.0			7.0- 8.0
F-3	29.0			9.0-10.0
G	--	6/4 or 14/11 14/12	All INTELNET	0.8-2.5 and up
Z	--	6/4 or 14/11 14/12	All	4.5-18.3
Non-Standard	--	6/4 or 14/11 14/12	All	--

*All earth stations can be used to access the international and domestic networks. However, the Standard Z earth station can have access only to domestic networks.

TELE VISUAL STRATEGIES FOR MARKETERS

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1. Abstract

For more than a decade strategic use of telecommunications has been quietly emerging as a key and often determining factor for marketing and business success. And, new opportunities to apply telecommunication solutions are increasing at a rapid rate. In the last few years, telecommunications technology has been complemented by various technologies and system solutions including video compression, laser optics, electronic image distribution, PC frame grabbers, graphic displays, and microcomputers. The opportunities for applying these telecommunications and visual capabilities in marketing, sales and training is the subject of this paper.

2. FRAMEWORK FOR OPPORTUNITY REVIEW

2.1 INTRODUCTION

The term tele visual used here refers to products, systems and applications that exploit the merits of telecommunications and visual presentation of people and information.

As you can appreciate, this would be a rather voluminous dissertation were we to attempt to deal with each of the technologies under these two broad categories. Therefore, our bias here will be to focus on relatively new systems and approaches with an emphasis on their utility in a marketing, sales and training context.

One way for dealing with the many different technologies and applications that fall within the generic telecommunications and visual domains is to develop a ladder of abstraction. Thus, I would ask you to view the framework from which tele visual opportunities are displayed in four general categories. Starting from the top of the ladder the categories are:

- Network and Service Offerings
- Products and Systems
- Integrated System Solutions
- Tele Visual Applications

In what follows below we will develop essential perspective on the first three categories in order to focus on marketing, sales and training applications of tele visual. We will also identify some of the pace setters. And finally, I will offer some opinions as to where I think some of this tele visual activity will lead.

2.2 NETWORKS AND SERVICE OFFERINGS

Direct Broadcast Network providers such as Private Satellite Network (PSN) and VideoStar are making significant inroads toward bringing tele visual capabilities to corporate America. These DBS networks are one way video and two way audio networks and are referred to as "business television" networks. Since 1984 there have been 13 video networks installed, and there is an expected 32 to be operational by year end 1986. The number of earth stations associated with these networks is perhaps a better reflection of business television activity. The number of U.S. operational earth stations including hotel chains at year end 1985 was approximately 2500, and projections for 1986 are at least half that number again.

Broadcast video for corporate use does not require dedicated networks. There are several so called ad hoc suppliers of turnkey special events and hotel chains video broadcast providers. Special events to marketers ususally translates to major product announcements.

Carrier networks including AT&T, GTE and the competing other common carrier group coupled with value added suppliers provide video communication and a wide variety of service offerings that we would classify as tele visual systems solutions for marketing, sales and training use. These offerings incorporate satellite and terrestrial networks, dedicated and on demand services. They include for example:

- Business Television (Broadcast)
- E-Mail (point to multipoint)
- Videoconferencing (point to point)

There is a third category of network and service providers that make available what I would call innovative value added networks. They include virtually all the special common carriers as well as many additional enterprising companies such as Digital Equipment Corporation, Honeywell, McDonnell Douglas Tymnet, Cox Communications, The Source and CompuServe.

These networks and service providers are generating many new information based services for marketing and sales organizations as well as

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consumers. The following graph is an example of such service providers and services:

NETWORK SERVICE
OFFERINGS

Provider	Service
Digital Equipment Corporation	All-in-1 and related products for sales and marketing including: electronic mail, sales operation/decision support, sales, information distribution and lead management.
Honeywell Inc.	Info Now and Order Now A videotex system for marketers providing central file access with graphics and text and order transactions.
Electronic Mail Corporation of America	GemService System Links private and public mail services and overcomes the compatibility issue.
MCI	MCI Mail Scripts Lets user create screen forms for order entry from field sales reps.
CompuSave	Electronic Retailing System Uses PC with videodisc giving consumers at retail grocery stores access to thousands of brand names with transaction capability.
Covidea	Electronic Banking Service Uses videotex system with home TV plus $100 terminals.

2.3 PRODUCTS AND TECHNOLOGY

In coming down the ladder of abstraction it is difficult to distinguish a full step in moving to this category. For the chicken and the egg syndrome clouds the issue. Nevertheless, the opportunities and synergism of networks and services and the following products and technologies is clear. The tele visual products and technologies that I consider to be of particular strategic value to a marketing, sales and training environment are:

- Audio - including analog and digital
- Facsimile - digital only
- Video - analog and digital, full motion and still frame
- Graphic Displays - including video monitors low, medium and high resolution CRT's
- Microcomputers (PC's) - and associated software
- PC Frame Grabber Boards - for micros
- Optical and Videodisc - including digital and analog mediums
- Video Compression - including full motion and still frame
- Earth Stations - emphasis on small aperture receive only
- Satellites - for all their inherent attributes particularly their broadcast economics

There are of course many more products and technologies that could be included as having contributing influences. A few of which are worth noting here that complement both the first two categories. They are multiplexors, modems, digital PBX's to include the emerging ISDN technology and finally T-1 and 56Kbs circuits.

2.4 INTEGRATED SYSTEM SOLUTIONS

Now we are at the level where we can integrate the tele visual products and networks and commence to visualize generic system solutions. Some sample tele visual solutions were referenced above. Here I would simply like to list currently available integrated system solutions capabilities. They are:

(1) Business Television - Direct Broadcast Satellite (DBS) analog, motion video with two way audio, point to many points.

(2) Facsimile Networks - broadcast and point-to-point.

(3) Electronic Mail Networks - both private and public using multifunction (and incompatable) terminals, broadcast and point-to-point.

(4) Information Access Systems - both private and public using PC's and mainframe capabilities including software management systems.

(5) Videoconferencing - mostly private networks where motion, video, audio and graphics are used point-to-point.

(6) Teleconferencing - private and public networks where still frame, video and/or graphics is combined with audio, point-to-point or multipoint.

(7) Store and Forward Systems - including voicemail, text and graphics solutions and still frame video.

(8) Interactive videodisc - with PC's used for training and point of purchase transactions, customer service and retail selling.

(9) Videotex Networks - combining information retrieval and transaction store and forward capability.

2.5 TELE VISUAL APPLICATIONS FOR MARKETING, SALES AND TRAINING

In this section I would like to return to our strategy for marketers theme. That is re-focus on marketers for whom the contention is made that tele visual solutions provide both strategic and productivity opportunities. We will take the nine integrated systems solutions from 2.4 above and review how they are serving the marketer. First, if you focus on the functional activities of the marketer you will observe there are several activities that marketing, sales and training people must do routinely. All of their activity involves information, knowledge transfer and communication, and this is independent of industry, product or service. I have listed below the salient activities and function for which these professionals are responsible for:

- Sales Presentations
- Product Introductions
- Management Presentations
- Briefings and Internal Staff
- Corporate Briefings to Key Accounts
- Customer Account Order Administration
- After Sales Support
- Sales and Product Training
- Product Information Distribution
- Product Information Services

It suffices to say there's nothing new here. These activities are the basics. But, business and marketing success is determined largely as the result of the effectiveness, timeliness and quality to which these basics are executed. Tele visual systems solutions are not new either. But many businessmen are finding that there are strategic, competitive, and market share reasons for deploying them effectively.

To facilitate our reviewing some specifics on what's being deployed by whom; I will break out the ten marketing functions into two groups.

Group One	Group Two
presentations, briefings, selling and training	customer and sales support, order administration and information distribution

2.5.1 GROUP ONE REVIEW

For sales presentations, product introductions, training, internal management presentations and briefings, and customer communications tele visual activity has been occurring via the following integrated system solutions:

(1) Business Television

(2) Videoconferencing

(3) Interactive Videodisc

Business Television - Direct Broadcast Satellite As cited above DBS network providers offer two kinds of service, single event and private (dedicated) networks. Single event video broadcasts have occurred in the last few years among many companies in the introduction or announcement of new products. Major sales meetings and management-to-remote-site briefings have been occurring as well. From 1980 to 1985 the number of single event conferences grew from 50 to roughly 500. In November of 1985 Texas Instruments held a single event with 34,000 participants at 476 earth station locations on the subject of artificial intelligence knowledge transfer. In 1984 Mary Kay Cosmetics included 130,000 sales people in an 80 site network including Europe, Africa and Australia.

Perhaps the more demonstrative occurrence of business television in terms of strategic implications is in the private network of DBS. Statistics were cited in an earlier section of this paper, thus, I would like to briefly identify some of the leading edge users. It's worth noting here that while our sales, marketing and training applications are frequently the first and easiest applications to justify, this is not always the case. Ford Motor Company's first priority, for example, was plain old better management communications to its people.

Leading edge private network users for Group One applications are:

American Hospital Supply

Chrysler

ComputerLand

Digital Equipment Corp.

Ford Motor Company

General Motors

Hewlitt-Packard

J.C. Penney

Merrill-Lynch

MicroAge

Tandem Computer

Wang Computers

Videoconferencing - In the past this tele visual solution has had two significant gating factors: (a) cost of outfitting meeting rooms with an array of special equipment including video compression codecs, and (b) availability and cost of transmission links. Both of these factors have been substantially improved over the last two years. The results have been after more than 5 years of pilot networks and search for better economics. Major companies are beginning to commit to videoconferencing networks using compressed motion video for applications in our Group One, as well as many other company internal operations. In fact, at this writing, in several of the examples used the primary use has not been marketing or training oriented or justified, but all have used their networks for these purposes.

Aetna

American General Insurance

ARCO

Boeing

CitiBank

Comdisco

Federal Express

Hambrecht & Quist

Hewlett-Packard

Hilton Hotels

Honeywell

J.C. Penney

IBM

Rockwell Int'l.

Sears, Roebuck & Co.

Standard Oil of Ind.

Tandem

United Technologies

United Telecomm.

XEROX

Interactive Videodisc - While this capability clearly belongs in our Group One, because of its increasing use in training, it has many application opportunities outside Group One and Two. Due to its inherent characteristics: vast storage of visual information, random fast frame access and PC control including graphic animations; it has considerable potential. In fact, its use in sales transactions picked up substantially in 1985, e.g., CompuSave Corporation struck agreement with Safeway Stores and other retail chain stores to install kiosk with access to 3000 brand items at prices 25 to 50% below retail. Finally, since we did not include service and maintenance or promotion in either Group One or Two, we need to add it here as an application for which this tele visual solution is capable of providing a productive tool for sales and training applications alone. The estimated interactive video systems for the U.S. in use, at year end 1985 was 40,000. While there are 100's of major and some not so major corporations using interactive videodisc, the market has yet to take off. Many including this author believe 1986 will be a break out year for the deployment of videodisc players and sales and training software to support them.

A list of users for this tele visual solution would be too long cited here and perhaps not as relevant in this context as an identification of key applications for sales and training including those applications outside our groupings.

- Product training - at vitually all levels

- Service training - from clerical to aircraft repairs and service

- Retail sales - point of sale merchandising

- Real estate - sales

- Industrial furniture - sales

- Travel services

Perhaps an effective way to realistically look at the potential for interactive videodisc use in training is to size the need and incentive of corporate training functions to take advantage of this solution.

According to the current survey of industrial training in America by Training Magazine (Oct. '85 issue), U.S. organizations will collectively deliver over 1.3 billion hours of formal training (hour equals one employee trained for one hour). For the categories entitled Sales Representatives and Customer Service combined, projected hours of training is 330 million or 24% of all delivered. training. Experience in recent years among the early users of interactive videodisc training including Digital Equipment Corporation and IBM indicate that only 1/2 to 1/3 of training time is required for subject matter covered, and retention is 3 to 5 times improved. How's that for productivity gains?

2.5.2. GROUP TWO REVIEW

For customer support, order administration, information distribution, and after sale support; tele visual activity has been occurring via the following integrated system solutions:

Electronic Mail (E-Mail) Networks

- Examples of public access networks are: MCI Mail, Western Union Easy Link, CompuServe, The Source, GemService Tymnet, and Telenet.

- Marketing examples of users applications include: customer service, order confirmation, international sales and service, information alerts.

Facsimile Systems

- An example of a private network is Signetics (Santa Clara, CA) Sales Office Network.

- Marketing examples of application use are similar to E-Mail above with the addition of signature verification and the use of graphics where required in applications such as order configuration verification and product (no color) picture to support specifications.

Information Access Systems

- Examples of systems providers are NDS Infomark's Market Research Database and DEC's All-In-One Product Line.
- Marketing and sales use includes: demographic and market segmentation analysis, product order and information access from field offices, inventory check, sales lead update and retrieval, customer order entry and confirmation.

Videotex Networks

- Examples of private network use include: Shelby Supply (industrial hardware), Clark Equipment Corporation Supply and Pacific Bell.
- Marketing and sales sample applications include: product catalog information retrieval, store and forward transactions, branch offices or dealer order processing.

Store and Forward Systems

- System and network provider examples are: NETI's DocuForum and VoiceCom.
- Sample applications include: contract and proposal prep coordination, internal company and customer messaging, customer order confirmation.

Teleconferencing Systems

- Examples of systems providers of still video and graphics would be: AT&T-IS and Colorado Video.
- Application use for marketing and sales would include: presentation preparation, advertising layout meetings, headquarters/ sales office meetings.

3. SUMMARY COMMENTS AND NEAR TERM OUTLOOK

The opportunities for applying telecommunications and visual media in marketing, sales and training are going to continue to roll out at a rapid rate in the near term. Network and service providers as well as product manufacturers are being both innovative and agressive toward providing what the marketer needs to become more productive and competitive. I say this with first hand knowledge and a pretty good accounting of both new offerings and successful implementation. This is as a result of our work and research at the Center, in producing the monthly marketing report entitled TELE VISUAL MARKET STRATEGIES. Each month the available news and successful tele visual implementation articles consistently surpass our capacity to edit and print 16 quality pages of useful informaion.

Perhaps even more revealing is the demand and need for productivity improvements among the functional activities of the marketer cited earlier. With a few exceptions, such as order entry and processing, enhanced market analysis, and computer based training; the last 20 years of computers and telecommunications growth has left the marketing, sales and training functions wanting. I find this particularly true when comparing these functions to the finance, administration, engineering and R&D functions. A colleague of mine, a marketer in a major computer company states that the last major productivity boost the marketer has had was the airplane. And, that was preceded by the automobile, which in turn, was preceded by the telephone. Until the 1980's I believe this statement to be more correct than not. However, the advances achieved and then productized in just microcomputers, video, and optics, coupled with networking, have established the basis for the roll out of marketing productivity and strategic tools.

By the end of this decade a wide range of tele visual strategies for marketers will have been implemented. What the computer and telecommunications was to the airline industry (via the now famous Saber reservation system) in the 60's and 70's, telecommunications combined with visual media will be to marketers in many other industries in the 80's.

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The TPC was founded in 1985 by Mr. De Baldo. Prior to 1985 he held several management posts in the telecommunications industry including Vice President of International Marketing and Vice President Marketing and Sales for Compression Labs Inc. and Manager of Tele Visual Market Development for Satellite Business Systems. Prior to SBS, he spent 13 years with IBM in communication and computer marketing assignments.

Recent Major U.S. Facilities-Related Policy Decisions: Letting a Million Circuits Bloom

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1.0 ABSTRACT

Three important decisions which will, or could, have an effect on telecommunications facilities development in the Pacific were made in the United States in 1985. The first was the approval by the Federal Communications Commission of U.S. carrier participation in fiber optic cable construction in the Pacific. The other two were the approval, in general, of the concepts of private carriage undersea cables and international satellites. The cost and variety of services for all telecommunications users in the Pacific could be affected by these decisions.

2.0 INTRODUCTION

The United States is the source of a significant amount of the international telecommunications traffic in the Pacific Ocean Region (POR). Indeed, a majority of the East-West telecommunications traffic across the Pacific terminates in the United States. Of course, the unique geographic spread of major communications nodes around the Pacific rim means that no single node is dominant.

Overall, telecommunications traffic in the Pacific Region has, since the late 1970s, been growing at an annual rate of 15-20 percent. This rapid rate of traffic growth no doubt reflects the increasing economic and social ties being forged across the Pacific between the United States and its neighbors in the region. Indeed, more than 50 percent of U.S. international trade today is with countries in the Pacific Region. The high rate of growth in telecommunications traffic has, of course, put a serious strain on the existing international telecommunications infrastructure. The stage was thus set in 1985 for major decisions to be made in the United States concerning when, in what form, and how additional transpacific telecommunications facilities should be deployed to allow for the smooth growth of traffic for the rest of the 1980s and the rest of the century. The decisions made in the United States will probably have a significant effect on all telecommunications users and service providers in the Pacific for the rest of the century. These decisions will affect not only the availability of services, but also at what cost they will be offered.

3.0 DECISION-MAKING IN THE U.S.

Decisions concerning new investments in international telecommunications facilities are made initially by the private sector in the United States. The main private sector parties are the U.S. International Service Carriers (USISCs), whose numbers continue to increase, and the Communications Satellite Corporation (COMSAT). Initial decisions by the USISCs concerning investments in new international undersea cables are usually made following consultations with foreign correspondents. COMSAT participates in International Telecommunications Satellite Organization (INTELSAT) forums to determine INTELSAT's requirements for new international satellite facilities.

Before private sector decisions to participate in the construction of a new international telecommunications facility can be implemented, however, they must be placed before the Federal Communications Commission (FCC) for approval. The FCC is composed of four commissioners and one chairman, supported by a large staff. The FCC is an independent agency which was established by the U.S. Congress under the Communications Act of 1934. As an independent agency, it does not directly take orders from the President of the United States, though its members are appointed by the President with the approval of the U.S. Senate.

As an independent agency, the FCC can receive advice and comments from the rest of the U.S. Government. Especially important is the Executive Branch, which is composed of the Office of the

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President and the cabinet-level departments. On international telecommunications matters the FCC most often hears from the Department of State; the National Telecommunications and Information Administration (NTIA), an organ of the Department of Commerce; and occasionally from the Department of Justice and Department of Defense. In addition, it is required to accept comments from the public, though the "public" providing comments is generally composed of the various communications providers and assemblages of users. The FCC reviews proposals for new investments by the USISCs and COMSAT to determine whether such investments will adequately meet the needs of the U.S. public at a fair and equitable price.

Traffic growth in the Pacific and the FCC's own regulatory timetable set the stage for it to make important decisions concerning "traditional" common carrier facilities for the Pacific in 1985. In addition, with the "help" of the Executive Branch, the FCC also in 1985 made important decisions concerning the lawfulness, in its view, of the establishment of private undersea cables and international satellites.

4.0 PACIFIC FACILITIES PLANNING PROCESS

The FCC has been conducting an inquiry into facility requirements in the Pacific since 1981. Unlike the North Atlantic Consultative Process (NACP), this Pacific Facilities Planning Process (PFPP) has been conducted largely in isolation. The NACP, which has been underway since the mid-70s, includes not only a broad range of U.S. domestic regulatory activities, but also international consultations on the senior and working levels. The FCC, when commencing the PFPP in 1981, sensed that other countries in the Pacific did not want to become enmeshed in the same sort of complex planning process as had developed in the North Atlantic.

The first phase of the PFPP focused on USISC facility requirements in the 1982-86 time frame. In its final order concluding Phase I of the PFPP, the FCC approved the purchase by the USISCs of a limited number of half-circuit Indefeasible Rights of Use (IRUs) in the ANZCAN North and South cables. Most of these IRUs were to be used for international traffic, though some were for domestic traffic between the U.S. Mainland and Hawaii. Many of the IRUs in the ANZCAN North cable were ordered to be held only until a new cable was built from California to Hawaii. While this new California-Hawaii cable was expected to be of fiber optic design, the FCC made no firm decisions about its design or implementation date. It set that issue off as the focus of a second phase of the PFPP.(1)

4.1 TIMING QUESTION

The FCC began Phase II of the PFPP in late 1983. This phase focused on Pacific facilities required between 1987 and 1995. The key issues for this phase were the timing and configuration of a new transpacific cable, presumably of fiber optic design. The date of implementation for such a cable was a key question because INTELSAT already planned to deploy two or three INTELSAT V/VA satellites into the region in a primary satellite and operational spare/major path satellite configuration (plus an in-orbit spare). It was estimated that such deployments would provide enough raw telecommunications capacity for the region to meet projected regional traffic growth into the early 1990s.

However, because the Haw-3/Transpac-2 cable system was already saturated by 1984, the balance of traffic carried by cables and satellites from the United States had already reached 70 percent satellite and 30 percent cable by 1985. Without a new cable facility, satellites could wind up carrying 80 to 90 percent of all U.S.-Pacific international traffic by 1990. The USISCs, who favored a new transpacific cable in 1988, argued that such an imbalance created certain traffic engineering risks, since it placed a large degree of reliance on one medium - satellites - and presumed that INTELSAT's deployment plans would go ahead as scheduled.

4.2 CONFIGURATION QUESTION

The configuration question -- where to land the cables -- had emerged during the first phase of the PFPP. The USISCs had proposed that the next transpacific cable be laid between Hawaii and Japan. The U.S. Department of Defense objected, however, because this configuration bypassed Guam, a key U.S. communications center in the Western Pacific. Guam was already a major landing point for both of the previous east-west transpacific cables, Transpac-1 (1964) and Transpac-2 (1975). NTIA objected because it felt a Guam terminus for Transpac-3 would give U.S. suppliers an important advantage in bidding for the contract to construct the system, if not allowing the bidding to be a U.S.-only affair.

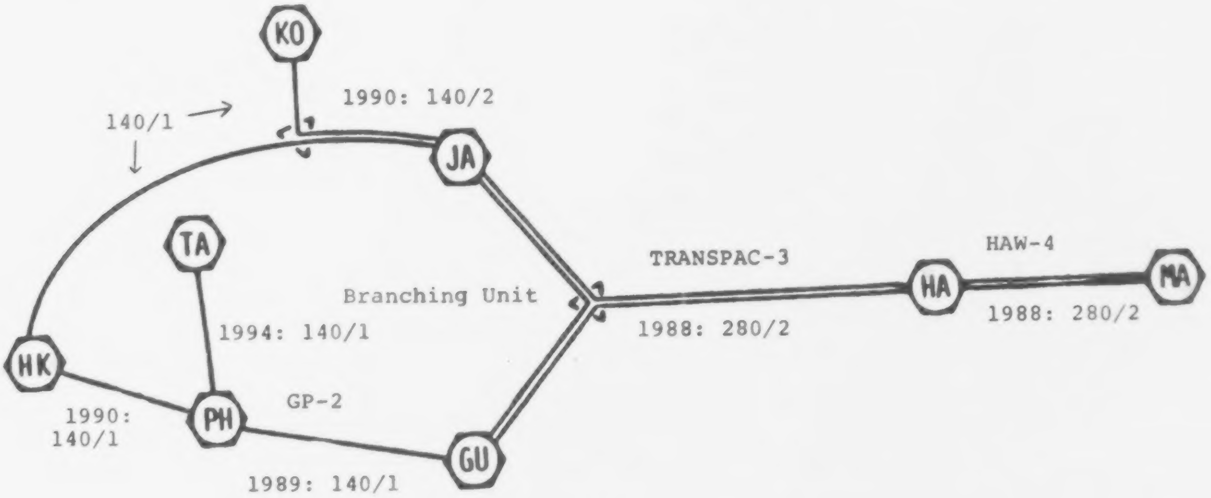
At the end of the first phase of the PFPP, however, the USISCs proposed a bifurcated configuration which would establish direct links between Hawaii and Japan, Hawaii and Guam, and even between Japan and Guam, through the use of an underwater branching unit located northeast of Guam. The USISCs carried this compromise configuration plan into the second phase of the PFPP, mollifying NTIA and the Defense Department. After some deliberation, the FCC finally accepted this plan (see Figure 1) for USISC participation in fiber optic cable development in the Pacific. The accepted plan not only included the Haw-4/Transpac-3 cable system, but additional fiber optic cables connecting major communications nodes in the East Asia/Western Pacific region. The FCC also decided that implementation of the high capacity Haw-4/Transpac-3 system could come as "early as 1988," even though this would potentially create a great deal of excess capacity in the region.

The Haw-4/Transpac-3 cable system proposed will have 280 Mbps of raw digital capacity, roughly equivalent to 18,900 voice circuits. In contrast, AT&T predicted that roughly 7,000 circuits would be needed for U.S. telecommunications to Pacific points via both satellite and cable by 1988. The USISCs argued, however, that it was more economical to lay a high-capacity cable, because reducing Transpac-3's capacity would not achieve significant savings.

The FCC said its policy decision was based on the following factors:

- a desire to promote new technologies; in this case, digital fiber optics
- concern that sufficient traffic be split among various communications paths so that a failure of one path would not affect all traffic between the U.S. and any one country
- a desire to promote intermodal competition between cables and satellites
- a desire to meet U.S. security interests in the Pacific.

FIGURE 1: PACIFIC FIBER OPTIC CABLE PLAN



LEGEND

GU - Guam
HA - Hawaii
HK - Hong Kong
JA - Japan
KO - Korea
MA - U.S. Mainland
PH - Philippines
TA- Taiwan

140/1 = 140 Mbps/one fiber pair

140/2 = 140 Mbps/two fiber pairs

280/2 = 280 Mbps/two fiber pairs

4.3 TRAFFIC LOADING

To protect the satellite medium from stagnation in traffic growth when the cables are placed in service, the FCC set out a loading plan by which an average of 65 percent of AT&T's new circuits during the period 1986-91 are placed on cable, the rest on international satellite. This will bring the balance between cable traffic and satellite traffic in the Pacific down to around 56 percent satellite, 44 percent cable by the end of 1991. In contrast, in 1987, the year before the implementation of Transpac-3, the cable/satellite balance will have reached 76 percent satellite and 24 percent cable. The FCC said it might cease stipulating traffic loading plans if competition between cables and satellites developed.(2)

Just two weeks after the release of the FCC's order, the USISCs filed their formal application, requesting authority to build Haw-4/Transpac-3 and a 140 Mbps fiber optic cable between Guam and the Philippines called GP-2.(3) GP-2 will be able to carry the equivalent of 9,450 voice circuits and will replace a 144-circuit Transpac-1 cable segment. The USISCs estimated the two projects combined would cost U.S.$700.7 million, of which 60.6 percent would be contributed by U.S. parties. The USISCs said in their application that they expected to activate Haw-4/Transpac-3 by December 31, 1988, and GP-2 in early 1989.

The FCC, as of December 1, 1985, had taken no formal action on these applications. No major problems are anticipated, however, since the FCC has already approved the basic plan.

5.0 EARTH STATION OWNERSHIP

Even before the FCC's Pacific Facilities order had been announced, another private sector decision had been made to change the roles of three of the major players. COMSAT announced in May that it would sell its 50 percent interest in the Guam INTELSAT earth station to RCA Global Communications, its largest partner (with a 48.5 percent ownership share) in the station. The transfer of ownership was proposed for December 31, 1987. A month later, COMSAT announced that it would sell its 50 percent interest in the three major U.S. mainland INTELSAT earth stations to AT&T. Transfer of ownership (which will leave AT&T with 97.5 percent of the ownership shares) was targetted for January 1, 1988. The three stations to be sold to AT&T are located at Jamesburg, California (the main West Coast international earth station); Etam, West Virginia; and Roaring Creek, Pennsylvania. The two other INTELSAT earth stations now active on the U.S. mainland (located at Andover, Maine and Brewster, Washington - the latter serving the Pacific) are to be retired by the end of 1986 under the agreement between AT&T and COMSAT.

COMSAT said that it was shifting its focus to small earth stations for the provision of INTELSAT Business Services (IBS) and television services. COMSAT will remain the U.S. Signatory to INTELSAT and will continue to lease INTELSAT space segment circuits to AT&T and other earth station operators in the United States.

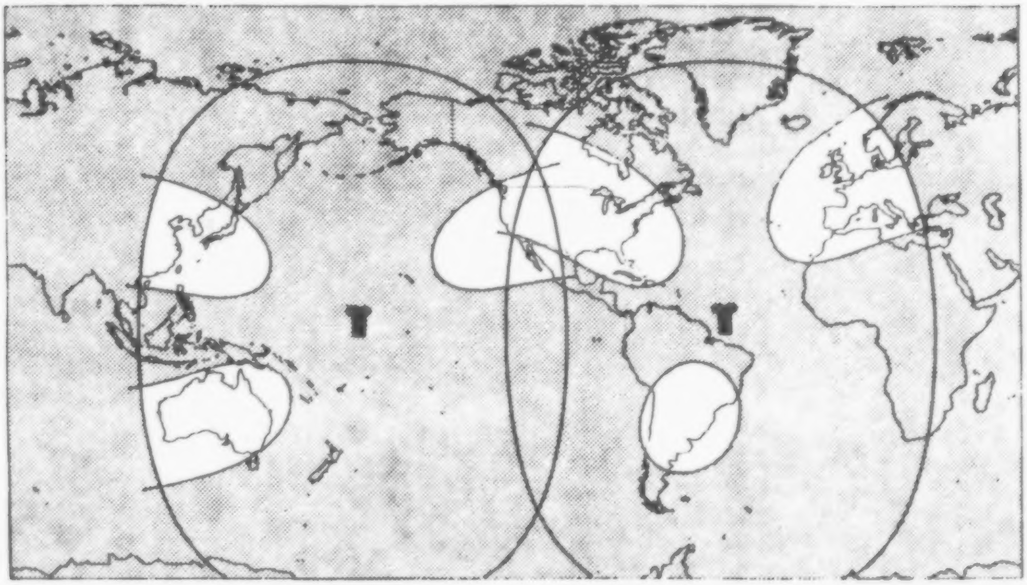
COMSAT's decision was precipitated by a policy decision made by the FCC in December 1984 essentially to allow open ownership of all types of international earth stations in the United States. Prior to this decision, the seven major stations located on the U.S. mainland, and in Guam and Hawaii, were owned by Earth Station Ownership Consortiums (ESOC), composed of COMSAT, AT&T, Hawaiian Telephone (in Hawaii), ITT World Communications (Hawaii only), RCA Global Communications (Globcom) and MCI/Western Union International in various combinations. COMSAT always held 50 percent ownership, while the party which was the next largest owner varied between AT&T (U.S. mainland), Hawaiian Telephone (Hawaii) and RCA Globcom (Guam). The FCC's decision created the potential for COMSAT's primary earth station services customer, AT&T, to build its own multipurpose international earth stations and divert satellite traffic to them. COMSAT apparently decided that the moment had arrived for a strategic repositioning of the company.

By December 1, 1985, there had been no announcements concerning changes in the ownership arrangements for the ESOC-owned earth station at Paumalu, Oahu, Hawaii. Nor had there been any announcement of change in the ownerships of the earth stations in Palau, the Federated States of Micronesia, the Marshall Islands, Saipan and American Samoa. COMSAT is the 100 percent owner of these earth stations.

6.0 PRIVATE SATELLITE DECISION

Whereas the Pacific Facilities Planning Process decision and the COMSAT earth

FIGURE 2: PROPOSED FINANSAT COVERAGE PATTERNS



station ownership decisions concerned what is called "common carrier" facilities, the FCC facility decision which got the most worldwide attention during the past year concerned so-called "private carriage" satellite facilities.

In March 1983, a start-up company calling itself Orion Satellite Corp. filed an application with the FCC requesting authority to build a two-satellite system to carry intra-corporate communications and television between the United States and Western Europe. This application was followed by six others: International Satellite, Inc. (ISI), in August 1983; Cygnus Satellite, in March 1984; RCA American Communications (RCA Americom), in February 1984; Pan American Satellite Corp. (PanAmSat), in May 1984; Systematics General Corporation (SGC), in June 1984; and Financial Satellite Corp. (Finansat), in May 1985. All but PanAmSat proposed to build systems serving the North Atlantic region. Finansat (see Figure 2) and SGC were the only ones to formally propose to serve both the Pacific and Atlantic regions. SGC withdrew its proposal to use NASA's Tracking and Data Relay Services Satellites in the Atlantic and Pacific regions to provide international and domestic service to the government in July 1984, six weeks after it was filed with the FCC.

These applications, of course, generated a great deal of objection from COMSAT and INTELSAT, as well as from many of INTELSAT's Parties and Signatories. The FCC initially asked the Executive Branch for its views because of the foreign policy implications of the applications. After lengthy review by an interagency committee, President Reagan issued a Presidential Determination on November 28, 1984 that private satellites would be in the national interest. (Such a "determination" is required by the Communications Satellite Act of 1962. The Act requires that the President determine if the U.S. national interest requires that satellites other than those of the global system be used.)

6.1 PRESIDENTIAL DETERMINATION

Along with the Presidential Determination, however, was a directive from the Executive Branch, authored by the Departments of State and Commerce, to the FCC. This directive instructed the FCC to devise a policy framework under which:

(a) Such satellite systems should be restricted to providing services through the sale or long-term lease of space segment capacity for communications not interconnected with the public-switched message networks;

(b) Final authorization should not be given to launch any of the proposed satellites until

> technical and economic coordination procedures under Article XIV of the INTELSAT Agreement has been completed. For such coordinations to take place, one or more foreign Parties to the Agreement would have to authorize the use of these systems and agree to take part with the U.S. in the coordination process.

In making these points, the Executive Branch reaffirmed its basic support for the INTELSAT system, but said it saw potential benefits to telecommunications users if these systems were allowed to proceed. In particular, note was taken of innovative services and higher powered downlinks proposed by many of these applicants in contrast to INTELSAT's then-existing range of services. The objective of the proviso barring interconnection with the public switched network was to protect INTELSAT's "core" business.(5)

6.2 FCC POLICY DECISION

In July 1985, the FCC made its long awaited policy decision.(6) The FCC said that not only would the private satellite operators be forbidden to directly interconnect with the public switched networks, but that this prohibition extended "to all levels of resellers and users" of their facilities. "Long term lease" was defined as one year and no minimum unit of space segment capacity for such leases was established.

All separate satellite systems were expected to complete coordination with INTELSAT before being granted authority to begin construction of their satellites. The FCC also set strict technical standards to ensure that full use was made of the geosynchronous orbital arc and its associated radio frequencies.

In issuing its basic policy statement, the FCC also gave preliminary authorizations to ISI, PanAmSat and RCA Americom. The FCC required Orion and Cygnus to amend the technical portions of their proposals to meet its requirements for full use of available radio frequencies, which they later did.(7)

The FCC did not act at that time on Finansat, the one applicant proposing Pacific service as well, because sufficient time for public comment on its application had not passed. On October 28, the FCC sent Finansat a letter noting that it did not meet its guidelines for full use of all C-band frequencies. The Commission asked Finansat to amend its application to conform with the policies it had adopted. Finansat was given 45 days to amend its application, a deadline it met on December 6.(8) At this writing, Finansat's application had not been acted upon by the FCC.

6.3 PACSTAR PROPOSAL

It is worth noting at this point, also, that the Administration of Papua New Guinea submitted information to the International Frequency Registration Board (IFRB) on February 15, 1985, for the advance publication of a two-satellite system called Pacstar.(9) As proposed, Pacstar would provide services to Papua New Guinea and regional services throughout the Pacific region. The two satellites are proposed to be located at 167 and 175 degrees West longitude. Diagrams in the advance publication document show C-band spot beams pointed at Papua New Guinea and neighboring island nations in the South and Central Pacific. Ku-band (11-12/14 GHz) spot beams are pointed at East Asian points from Japan to Indonesia on the West and at Hawaii and California on the East. The documentation states that the satellites would be brought into service at the end of 1989. Little additional information about this system has been available. No application for authority to work with this system has been filed with the FCC, though TRT Telecommunications, a Washington, D.C.-based international record carrier, has acknowledged that it is affiliated with the Pacstar proposal.

7.0 PRIVATE CABLE ISSUE

The final major international telecommunications facility-related decision the FCC made in 1985 concerned the proposed construction of private undersea fiber optic cables in the North Atlantic. Two start-up companies, Tel-Optik Limited and Submarine Lightwave Cable Company (SLC), filed applications to build such systems in September and October 1984, respectively. Both companies proposed to sell or lease capacity on their systems on a non-common carrier basis to private users. Tel-Optik proposed to build two cables, both landing in New Jersey and the United Kingdom, leaving at least 280 Mbps in capacity. It proposed to put its first cable into service in 1989, the second three years later. Tel-Optik proposed to share ownership of these systems with Cable and Wireless PLC, the British communications company. SLC proposed, on the other hand, the build one 6.7 Gbps capacity system with multiple landing points: in the United States and Canada on the West, and the United Kingdom, Spain and France on the East. It also proposed a 1989 ready-for-service date.

Once again, as with the applications for satellites to be used for private carriage, the FCC was faced with a novel policy question. In this case, however, no international treaty appeared to present a bar to such systems. Nor, for that matter, did these two applications precipitate an avalanche of criticisms from foreign governments and telecommunications administrations.

A primary question was how to fit these applications into the NACP. The FCC finally decided that this question need not be considered now because no common carrier was proposing at this time to use either of the two systems.

Thus, just five months after Tel-Optik's application was filed, the FCC issued its basic policy statement approving the concept of private undersea cables.(10) By June, it had issued cable landing licenses to both Tel-Optik and SLC.(11)

8.0 MEANING FOR PACIFIC TELECOMMUNICATIONS USERS

These three major decisions during the last year in the United States will probably have a significant impact on all telecommunication users in the Pacific in the years ahead. The FCC decision to approve the basic outline for common carrier telecommunications facility development in the Pacific sets the stage for massive increases in telecommunications capacity starting almost immediately. INTELSAT is already moving to position two high capacity INTELSAT V satellites in the Pacific Region. They are scheduled to be on station in the first quarter of 1986. Each satellite will double the basic capacity of the INTELSAT IV-A it will replace. For the first time, also, the Pacific will have an opportunity to experiment and use Ku-band, with which the INTELSAT V satellites are equipped. INTELSAT, of course, had already planned for the deployment of these satellites and did not need the FCC's authorization to do so. However, the FCC authorization last July allows the various U.S. carriers, especially COMSAT, to participate fully in the use of these satellites.

The question remains whether this great increase in capacity will become a boon to telecommunications users in the Pacific, or a burden, because of the large investment required. While the USISCs pointed to the remarkably low cost per circuit of Haw-3/Transpac-2 in their application (on the order of $8,000 per half-circuit in comparison with the original cost of Haw-3/Transpac-2 half-circuit - $127,600) (12), one cannot overlook that this is a $633.7 million investment. Of importance to U.S. telecommunications users is the fact that 63 percent of the investment in Haw-4/Transpac-3, or about $400 million, will be the responsibility of the USISCs. This expenditure will be spread, in the initial years at least, over a relatively few half-circuits. For the USISCs, this may amount to approximately 15,000 half-circuits, both cable and satellite, by the end of 1991.

Two possible scenarios are foreseeable. Common carrier tariffs could go up as a result of this heavy, one time investment. Or, the USISCs may lower them in the hope that demand will be spurred. The continuance of a loading scheme for AT&T will not hinder this, because existing "long fall" policies require that greater than expected growth be spread equitably over both the cable and satellite medium.

For U.S. telecommunications users, the second scenario seems the more likely, though by no means a sure thing. The increasing competition in the international services market with the entry of such new players as GTE Sprint, MCI International and even COMSAT's new retail subsidiary, COMSAT International Communications Inc. (CICI), will encourage rate cutting and the development of new services. Few companies have applied to the FCC to build IBS earth stations facing the Pacific, as opposed to Atlantic, INTELSAT satellites. Nevertheless, increasing competition in the INTELSAT earth segment services market in the U.S. can be anticipated as a result on the FCC's Earth Station Ownership Decision.

How far such competition on the U.S. side progresses will, of course, depend in large measure on how willing foreign administrations are to deal with new U.S. entities. Whether the telecommunications users in the rest of the Pacific will also benefit from the vast expansion of capabilities which is underway in the Pacific will depend, of course, on whether their administrations respond to the spirit of competition and liberalization which has taken root in the United States and which seems to be sprouting in Japan.(14)

An outstanding question is, also, whether the decisions in the United States in 1985 to introduce wholly new elements to the international telecommunications scene - private satellites and cables - will find fertile ground in the Pacific. The potential for private undersea cables seems somewhat remote at this point following the decision to proceed in 1988 with the high capacity Haw-4/Transpac-3 system. The cost of constructing a transoceanic cable in the Pacific, of whatever design, in comparison with the overall level of traffic in the region, would appear to militate against such a project.

The potential for private satellites separate from INTELSAT remains an open question, though there appears to be a great deal of activity on this front. One system, Pacstar, has already made its plans known to the world through the IFRB. The Pacific Telecommunications Conference has also heard about studies underway in Japan of the market and requirements for a regional satellite.(15) And, there is the Finansat proposal.

Whether these proposals proceed will no doubt depend on the success INTELSAT and other systems, such as AUSSAT, have in meeting as-yet-unfulfilled requirements for satellite communications services in the various markets of the Pacific Basin. As in any competitive environment, failure to respond to market requirements creates opportunities for competitors.

9.0 SUMMARY

The Pacific is becoming a scene for high stakes gambling on the part of communications services providers and would-be providers. Whether telecommunications users will benefit from this high stakes gambling has yet to be determined, though the prospects seem promising at this point. The benefits for telecommunications users will be in the form, in this case, of more diverse and cheaper services. Many key policy questions have now been resolved in the United States. The focus must now shift to its neighbors in the Pacific, who must decide whether they are willing to comtemplate the establishment of a very different environment for telecommunications in the Pacific.

Notes

(1) Pacific Facilities Planning (Phase I), Report and Order, 47 Federal Register 57040 (December 22, 1982).

(2) Pacific Planning (Phase II), Second Report and Order, CC Docket No. 81-343, released August 22, 1985.

(3) American Telephone & Telegraph, et al., Application to construct and operate high capacity digital submarine cable systems between and among the mainland of the United States, the Island of Oahu in the State of Hawaii, the Island of Guam, Japan and the Island of Luzon, Philippines, filed September 4, 1985 with the Federal Communications Commission, File No. I-T-C-85-219.

(4) Earth Station Ownership, Report and Order, CC Docket 82-540, released December 18, 1984.

(5) Letter to Mark S. Fowler, Chairman, Federal Communications Commission, from George P. Shultz, Secretary of State and Malcolm Baldrige, Secretary of Commerce, 28 November 1984.

(6) Separate International Satellites, Report and Order, CC Docket No. 84-1299, Released September 3, 1985.

(7) Orion Satellite Corporation, Memorandum Opinion Order and Authorization, File No CSS-83-002-P, released September 6, 1985; and Cygnus Satellite Corporation, Memorandum Opinion Order and Authorization, CSS-84-002-P(LA), released October 22, 1985.

(8) Letter to Kenneth Susskind, Financial Satellite Corporation, from Albert Halprin, Chief, Common Carrier Bureau, Federal Communications Commission, File No. CSS-85-004-P(LA), October 28, 1985.

(9) International Frequency Registration Board, Advanced Publication of Information on a Planned Satellite Network/ Special Section No. AR11/A/200-201 (Pacstar-1 and Pacstar-2), 18 June 1985.

(10) Tel-Optik Limited and Submarine Lightwave Cable Company, Memorandum Opinion and Order, released April 5, 1985.

(11) Tel-Optik, Limited, Cable Landing License, released May 17, 1985; and Submarine Lightwave Cable Company, Cable Landing License, released June 19, 1985.

(12) American Telephone & Telegraph, Ibid., p. 28.

(13) Ibid., Schedule B.

(14) Moriya Koyama, Administrative Vice-Minister of Posts and Telecommunications, "New Communication Age in Japan," Keynote Address, Pacific Telecommunications Conference '85, 13 January 1985, Honolulu, Hawaii.

(15) Research Institute for Telecommunications and Economics (Japan), "A Study on the Pacific Regional Satellite Communications System," Pacific Telecommunications Conference '83, Honolulu, Hawaii, January 16-19, 1983.

Canada's Telecommunications Policy Review

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Abstract

On 20 June 1985, former Canadian Minister of Communications, the Hon. Marcel Masse, initiated a comprehensive review of the national telecommunications policy. This paper investigates the factors which prompted the review and examines its guiding principles. An assessment of the possibility of a "Made-in-Canada" telecommunications policy is offered.

The invention of the telegraph in 1835 signalled the beginning of Canada's telecommunications industry. Since then, the system which evolved has met successfully the demands of our fragmented regions. Today it serves ninety-eight percent of Canadian households with a technical infrastructure worth more than twenty billion dollars.

Undoubtedly, telecommunications is big business in Canada but its importance cannot be determined solely on the basis of industry assets and revenues. As the provider of essential services required by two of the fastest growing sectors of the economy - - the information-based and high technology industries, telecommunications is vital to the overall health of the Canadian economy. According to the Honourable Marcel Masse, former Canadian Minister of Communications, "The Canadian telecommunications system is, quite rightly, a source of Canadian pride internationally. It is technologically advanced, very reliable, widely accessible, and universally affordable. It meets the needs of Canadian business, the demands of our geography, and the desires of our citizens to communicate with each other from coast to coast, Atlantic to Pacific. It is an instrument of economic growth, an instrument of national unity, and an instrument of benefit to society."(1)

Despite its past successes, the Canadian telecommunications industry is facing a future which promises to be both changing and complex. A number of domestic and international forces beyond the control of the industry and responsible governments are calling current technological, economic, and political frameworks into question. The future holds forth the possibility of hitherto unconsidered options for the delivery of telecommunications services to increasingly sophisticated consumers.

In response to these challenges, Communications Minister Masse, acknowledged the need for a more comprehensive approach to policy formulation in the telecommunications sector. On 20 June, 1985, he announced the intention of the government to conduct a thorough review of telecommunications policy in response to "...great pressures for change - - from both inside and outside the system and the country."(2)

The proposed review, however, is likely to involve highly sensitive, even contentious, issues. The resulting policy proposals will have important social, cultural and economic ramifications for the whole nation, affecting not only governments, carriers and business users but also individual Canadians. Despite the potential problems, the Minister is convinced of the need to proceed with this policy debate. "(T)he continued survival and prosperity of Canadian telecommunications is far too important to jeopardize through political indifference or bureaucratic arrogance. Its significance to all Canadians is too great for it to be restructured or otherwise changed without full public debate, and there must be full public awareness of the implications and the consequences."(3)

The purpose of this paper is to examine the factors which have forced a policy review, investigate the issues raised and assess the likelihood of Canada independently developing its own telecommunications policy. The research undertaken involved not only an extensive computerized literature search but also a series of interviews with knowledgeable individuals currently working in the telecommunications industry. The factors identified fall into three categories: technological, economic and political. Each will be discussed in turn.

TECHNOLOGICAL REASONS

Currently a number of monopolies, guided by regulatory forces, dominate the Canadian telecommunications market. Economies of scope and scale, exaggerated by the vast size of the country and its widely dispersed population, have reinforced this market structure as an efficient and effective method of providing telecommunications services. Under these conditions, governments have been able to ensure that new technologies benefitted their constituents and carriers have maintained their positions at the leading edge of the technological revolution. Recent developments, however, question the continued validity of that scenario. Rapid advances in telecommunications technology are forcing a rethinking of current market structures and policy agendas. Future possibilities are almost limitless. The new technologies offer not only greater transmission capacity and expanded choice of transmission modes, but also the possibility of competition in the delivery of telecommunications services.

Two major sources of technological change exist. The first is found within the telecommunications industry itself. The other is created by the convergence of communications and computers. The development of solid-state microelectronics has had a massive impact on the telecommunications industry by integrating data processing, storage, retrieval, and communications functions. In addition, reductions in size, cost and power consumption have been accompanied by increased speed, reliability, capability and capacity.

Although the "traditional" transmission technologies, paired copper cable, microwave radio and coaxial cable, each has its disadvantages when compared to the new technologies, they do form the basis of the current telecommunications infrastructure. For this reason, wholesale replacement is prohibitively expensive, however, future installations increasingly will utilize the new technologies including satellites, mobile cellular radio, optical fibres, digital transmission and switching and many more. For the present, recent improvements to existing technologies have increased their capacity in order that they may be better utilized to meet growing demands for service.

In conjunction with these innovations, other technological developments occurred that supplemented and enhanced them. These technologies are more efficient, reliable and flexible than their predecessors. They permit the integration of voice, video and data and allow for functions other than basic communications to be accommodated. They also enhance and encourage the interconnection of data bases through the development of networks. In sum, these innovations and improvements have created new information services and distribution systems.

There is disagreement within the Canadian telecommunications industry with respect to just how rapidly these new technologies will be adopted and utilized but all respondents in the study agree that the telecommunications environment in the year 2000 will be dramatically different because the eventual acceptance of these new technologies will lead to further trends. It will create a proliferation of new services. Business will demand services and equipment packaged to meet its individual requirements. However, a high degree of compatibility will also be required so as to permit access to a wide variety of other systems and data bases. Furthermore, business users will want greater choice in the selection of hardware. This flexibility is a highly valued attribute.

Moreover, there was general agreement among industry representatives that due to technological advances long-established boundaries within the telecommunications sector, such as local service and long distance, are eroding. So are the boundaries between this industry and others in the information business. The integration of voice, data and video and the convergence of computers and communications have removed the factors which once separated and defined the telecommunications sector. In addition, new and improved technologies can provide alternatives to the traditional range of telecommunications services once offered. Finally, there is concern that national boundaries, too, are less distinct and this threatens the stability of the national industry.

The impact of these changes, then, has been to increase the degree of competition which exists within the industry. The current regulated monopolistic structure is under attack from a broad range of sources both within the industry and outside of it. A number of alternative market structures and policy positions have been proposed. Each needs to be thoughtfully assessed.

ECONOMIC REASONS

Without the numerous and rapid technological innovations in the telecommunications and related sectors, competition in the delivery of services would not be likely. However, the major impetus for increased competition and the Canadian government's review of current telecommunications policy may be found in the economic sphere. The value of the telecommunications industry to Canada's economic development cannot be overstated. Currently the Gross Domestic Product for the telecommunications services sector is growing at a higher rate than the GDP for the overall national economy. One major purpose of the review is to ensure the industry's continued ability to function effectively. This means that future policy decisions should reflect the growing number of competitive marketplace forces.

Competition within the telecommunications sector involves three industries once considered distinct - telecommunications, data processing and office products. These boundaries are blurring, however, as the market expands and diversifies. The once stable industry is increasingly "volatile and variable"(4) and there is worldwide pressure for change. Whereas protected monopolies were once assumed necessary to the efficient functioning of telecommunications infrastructures, that presumption is presently being challenged. It is now argued that monopoly is nothing more than the ability to manipulate prices and eliminate competition unilaterally.

A global trend towards deregulation is evident within the telecommunications industry. Proponents argue that a competitive market offers several economic advantages. It promotes the efficient management of telecommunications suppliers. Prices are forced closer to costs and consumers benefit from lower rates. Competition also encourages innovation and quality control. The number of services and suppliers increases and customers have expanded choice. Furthermore, it is argued that competition has positive effects on a country's economy by strengthening its position in the world market.

Both government and industry are aware of the potential for growth in the telecommunications market. For example, Telecom Canada's(5) long distance revenues increased 350 per cent between 1974 and 1982. Continued growth is expected because an ever larger number of businesses rely on instant communications and access to information. Moreover, consumers, especially business users, are becoming increasingly sophisticated. They are now demanding user-oriented services at lower prices.

These new demands are fueled by an awareness of developments in the United States. Traditionally, both the Canadian and American systems have offered similar services and pricing options and adopted common technologies and structural frameworks. Canadians, aware of the structural changes in the American industry, the proliferation of available services, and the reductions in long distance toll charges, are frustrated by the limitations at home. Business users are particularly anxious. Not only do their American competitors have access to new productivity-enhancing business services but long distance rate reductions have substantially reduced overall expenses. Canadian business argues, therefore, that these major cost advantages for U.S. firms make it impossible for Canadians to compete in an open market.

Increasingly, Canadian business users are attracted to the new American carriers who are beginning to operate in Canada. These carriers "bypass" the Canadian telecommunications infrastructure and offer varied services at low cost. U.S. carriers currently have marked cost advantages over their Canadian counterparts, including a larger base market and freedom from most of the regulatory restraints imposed on Canadian carriers. Moreover, once they have an established infrastructure in the U.S., additional costs to move into the Canadian market are marginal while the opportunities to increase market share are considerable. They can, therefore, offer competitive services at much lower rates, particularly in urban centres, and thereby undermine the position of Canadian carriers.

The impact of American entrants has already been felt by at least one Canadian telco. Longnet, an American firm, currently sells cheap long distance services to U.S. destinations to users in British Columbia.(6) On 4 April 1985, B.C. Tel was granted permission by the Canadian regulator, the CRTC, to systematically reduce selected long distance toll charges in order that it could more effectively compete against Longnet and others. This situation raises two questions. First, how often will Canadian telcos be forced to reduce long distance rates as a result of foreign competition? Second, and perhaps more important, at what point will local rates be forced upwards, in some cases significantly, in order that Canadian carriers may retain their traditional levels of profitability? The answers to these unresolved questions will effect the functioning of the entire Canadian telecommunications system.

For this reason and others both industry and government are anxious. The policy decisions made now will determine the future success of the Canadian telecommunications industry and possibly the entire economy. Both sectors recognize that decisive policy initiatives are necessary to promote a stable industry that can attract the resources necessary to finance new services and systems and to intensify the research and development efforts which will permit Canada to remain at the forefront of the industry. Both sectors also acknowledge the opportunities for job maintenance and creation in a thriving telecommunications industry. However, both are also aware that simple deregulation may not be the panacea.

Increased competition can have adverse consequences for consumers and the country. "Canadians consider cheap and reliable telephone service their birthright."(7) Universal service is the cornerstone of the Canadian telecommunications system. However, without regulation, carriers may be reluctant to undertake unprofitable services such as the provision of basic service to rural and remote locations. There is also a fear that residential and rural rates will escalate as common costs are shifted to those who have no "bypass" alternatives. Basic service rates may increase to a point beyond the reach of some Canadians. In a society that is increasingly information-based, the discrepancy between "haves" and "have-nots" will be exaggerated.(8) Furthermore, the American experience with deregulation has proven very confusing for the residential consumer who witnessed substantial increases in his/her monthly bill but recognized no additional benefits.(9)

Another fear questions the ability of actors in the telecommunications sector to compete fairly. Economies of scope and scale may continue to inhibit competition, especially with the introduction of foreign entrants. Furthermore, in a market in which some services and/or suppliers are regulated and others are not, predation is a possible outcome. Contrived barriers may prevent or foil the entry of new suppliers. Alternatively, fierce competition may also be undesirable. Profitless growth creates disenchantment. Product quality and research and development suffer. Eventually, most smaller firms withdraw, are forced from the market, or merge with larger ones. In any case, an oligopoly may result.

The Canadian telecommunications industry is currently very successful in providing the basic services required by Canadian consumers. For this reason, many of the study's respondents believed that little change would be accepted in the basic market structure of this industry. Despite the advantages of competition, the government is unlikely to accept a truly competitive telecommunications industry. However, almost all industry representatives favoured more competition. Some insisted that it was an inevitable development. Conversely, however, few respondents favoured the introduction of foreign competition. Most agreed that such a development could have only negative effects on the provision of telecommunications services in Canada. The presence of such conflicting economic opinions makes the government's decision-making task even more difficult.

POLITICAL REASONS

The third set of factors which prompted Communications Minister Masse to undertake a telecommunications policy review are political in nature. Not only will the decisions made have important economic consequences but they may also signal significant shifts in political, legislative and regulatory frameworks as well. The current regulatory structure is highly complex, involving federal, provincial and municipal governments. Most carriers are regulated but some are not.(10) This structure evolved, in part, because of the three major objectives which have guided the development of telecommunications in Canada: universal access, Canadian sovereignty and regional development.

Universal access is promoted through a number of regulatory policies. Regional telcos are required to provide service in both profitable and unprofitable areas. The basic pricing principles established serve to create an elaborate system of income redistribution, whereby business users, urban communities and long distance toll charges make larger contributions to the common telecommunications costs than do residential users, rural residents and local rates. Although these practices have caused the telcos some financial strain, they have kept local rates low, thereby helping to enlarge the size and value of the public network. Moreover, because they are not neutral and unbiased, the selection of technologies involves questions of equity. By setting technical standards and ensuring compatibility, regulation seeks to promote universal access. Finally, regulation compensates for market failures and prevents monopoly abuses. No special interest is permitted to gain a concentration of control to the detriment of the general public.

The second major objective is the maintenance of Canadian sovereignty. Fear of foreign domination intensifies as the nation's dependence on information, both economically and socially, increases. In order to protect Canada's identity and cultural sovereignty, regulators have attempted to develop a framework in which a strong national industry can exist, which reflects Canadian values and needs, is subject to Canadian laws and responds to Canadian policy objectives.

The regional development objective is also a broad one. Although it varies from region to region, telecommunications is expected to play an integral role in any development scheme. Regulation allows governments to impose development responsibilities on the telecommunications sector in order to achieve much broader goals, such as employment creation.

Despite the unarguable fact that regulation seeks to promote laudable goals, the regulatory framework is under severe strain. Many argue that its focus is too narrow. It has failed to acknowledge the marriage of the telecommunications and computer industries which has eroded many traditional boundaries. Moreover, regulators should cease to be preoccupied with possible abuse and begin to assess their decisions in terms of long-range opportunities not short term adjustments.

The current pricing structure offers an example. Stanbury and Thompson see it as the most important barrier to deregulation.(11) It is criticized as grossly inefficient, inequitable and unresponsive. With the advent of competitive and bypass technologies, carriers are demanding rate rebalancing - prices should reflect costs. The problem, of course, is that higher rates threaten universal service. Many solutions to this problem have been offered including life-line rates, direct government subsidies and multi-party service. However, regulators are aware that rate rebalancing creates the impression of inequality--business users will experience dramatic savings but average subscribers will confront higher rates. For this reason, they are reluctant to make the kinds of decisions which will affect the long-term viability of the industry.

Others have criticized the regionally fragmented regulatory system which presently exists and which defies logical explanation. Federalism, constitutional ambiguity and rapid technological change make it difficult to achieve a cohesive, compatible national policy. The "regulated" believe that a settlement of the jurisdictional entanglement is "...an integral and essential component of any effort to rectify or improve telecommunications policy in Canada".(12) Undoubtedly, regional differences cannot be ignored. Moreover, the federal government wants more directive power. Therefore, contentious issues will need to be addressed in a renewed spirit of consultation and co-ordination.

Finally, the carriers argue that regulation prevents them from operating their businesses in the most efficient manner possible. Regulatory restrictions slow the adoption of new technologies and inhibit flexible responses to market demands. Furthermore, regulation is costly in terms of both time and money. The regulated carriers claim that consumers are bearing the heavy burden of continued regulation and the country will suffer for it.

Many observers have concluded that the information technology is beyond regulatory control. It cannot be managed. To date, regulation has not kept pace with technological change. The convergence of communication and computer technologies has not been recognized. Not only is monopoly no longer necessary in many sectors, it may not be possible or where possible, perhaps dysfunctional. The ability of regulators to effect change has been markedly reduced. Technological determinism is a reality which has impacted on both the telecommunications market and its regulatory framework.

Widespread support for reform of the regulatory system exists. Opponents and proponents alike, are aware of the limitations of regulation. Its tools are limited; its process, adversarial; its time-frame and bureaucratic requirements, a burden. Currently, regulation is a blunt instrument. Many argue that reform is required to make regulation more flexible and anticipatory, reflective of the technological realities of the Communication Age. There needs to be a recognition of present realities and future potentials. According to Dealy, regulation should begin to address society's changing needs not its own past principles.(13)

CONCLUSIONS

Communications Minister Masse proposed a telecommunications policy review which is expected to involve extensive consultation with those Canadians who are concerned with this issue including representatives of the provincial governments, carriers, labour unions, consumer associations voluntary organizations and other groups. The review is to be guided by four principles which will serve "to ensure that Canadians can still communicate with each other, whenever and wherever the desire and the need arises."(14)

1. The policy must preserve universal access to the telecommunications system at affordable prices.
2. Uniquely Canadian solutions must be sought.
3. The policy must ensure that the Canadian telecommunications sector remains at the forefront of technological progress and benefits all Canadians.
4. Canadian competitiveness in international markets must be maintained.

The Minister acknowledges the vital nature of the telecommunications system and recognizes the challenges which must be addressed by any new policy initiative. "Telecommunications does not present a series of either or choices -- it presents multiple options, both to policy makers and to users of the system. Our task, as concerned Canadians, is to ensure that the system remains healthy, continues to grow, and presents us with even more options in the coming decades than we can currently imagine -- and that it does so while providing jobs for Canadians, and world-class services for Canadian businesses, and a full contribution to an internationally-competitive economy."(15)

Given the compelling nature of recent technological changes in the telecommunications industry which are international in scope, what are the chances of the Canadian Communications Minister achieving his objectives? Is a "Made-in-Canada" telecommunications policy possible? This paper argues that it is not. Many analysts believe that the technology is determining, not only the manner in which the market functions, but also the public policy decisions made by the "governors". Even if one rejects these theories of technological determinism, the impact of technological innovation cannot be ignored. Modern techniques are making it virtually meaningless, for policy purposes, to differentiate among different sorts of carriers delivering different types of transmission signals. These boundaries are blurring and their use for policy purposes is increasingly artificial.

Moreover, the literature reveals that the realities of these technological developments have made increased competition inevitable. There are no longer technical grounds for continued monopolies in many service sectors. The extent of the possible choices available to users has expanded and costs are declining. The consumer wants greater flexibility and the attendant benefits of increased choice.

In addition, increased capacity and capabilities offer enhanced opportunities not only to domestic suppliers, but to international ones as well. Foreign suppliers, especially American ones, can extend service to the Canadian market for little additional cost but the benefits to be gained are significant. These new entrants, some with several years of experience in a competitive environment, operate outside the regulatory restraints which constrain domestic actors and thereby are afforded additional advantages.

These factors, alone, mitigate against the effectiveness of a domestic telecommunications policy but when one also considers the impact of the American market model, the possibility is further limited. The entire Western world relies on the United States for its example of how to operate a successful industry. The impact of that model on the Canadian telecommunications environment is intensified by two related factors. Canada's proximity to the U.S. heightens the impact of the American experience. Moreover, the Canadian and American telecommunications markets have traditionally been very similar. Canadians are accustomed to having the same services as their American counterparts, at similar prices. Many domestic suppliers and consumers are looking to the U.S. and increasingly demanding the advantages enjoyed by Americans.

This leads, therefore, to questions with respect to the current regulatory environment. Most analysts applaud the stated regulatory objectives, but criticize the established framework as unworkable. Divided regulatory control means that there is no one authority for determining the national priorities. Regulatory agencies are making public policy decisions without the benefit of national political directions. Moreover, since each jurisdiction establishes its own rules, the acceptance of technological innovation, competitive market structures, and market-based pricing principles vary across the nation. When this situation is assessed in terms of the standard economic policy criteria of growth, equitability and efficiency the continued success of the Canadian industry is questionable. Indeed, some maintain that even with a national authority establishing the goals, Canada's future as an information economy may still be impaired because of the increasing amount of trans-border traffic and the entry of international suppliers which operate outside of the jurisdiction of Canadian authorities.

Moreover, the concept of the "regulatory burden" was one which consistently resurfaced. Not only must regulated carriers expend considerable amounts of time, effort and money to provide the materials and information required by regulators but they also must abide by the ultimate regulatory decisions which frequently take many months to be decided and which may impose further increased costs on the regulated entity. By contrast, new entrants are not necessarily subjected to either of these burdens. They reflect a free enterprise orientation and as competitors in the telecommunications sectors, are allowed a systematic advantage since they do not operate under the same regulatory constraints. This consequence questions the concept of a level "playing field" for all telecommunications participants.

In sum, the Canadian regulatory environment in the telecommunications field is constantly compared with activities in the United States. Since it now represents such a drastically altered model in terms of deregulation, Canadian policy-makers have to examine it closely. In addition, and perhaps of greater consequence, is the fact that technological expansion and innovation in telecommunications is moving at such a rate and in such a direction as to make "heavy handed" regulation almost an impossibility. Given these two factors, it does appear that certain substantial changes are going to be required in both the approach of Canadian regulators of telecommunications whether at the federal or provincial level, and the provision of a regulatory environment that has as a goal, marketplace mechanisms that will lead to Canadian successes in the telecommunications field. These successes in turn, should form the basis for international sales and expansion of telecommunications systems developed and manufactured in Canada.

Unfortunately many of these decisions have been taken out of the hands of Canadian legislators. All that remains is for them to mimic the activities of the successful American system by removing the legislative and regulatory restraints in the hope that the Canadian industry can respond successfully.

END NOTES

(1) Masse, The Honourable Marcel, "Address to the Electrical and Electronic Equipment Manufacturers' Association of Canada," Montebello, Quebec, 20 June, 1985, (Mimeographed.), p.9.

(2) Ibid., p. 10.

(3) Ibid., p. 9.

(4) Brian R. Woodrow and Kenneth B. Woodside, "Players, Stakes and Politics in the Future of Telecommunications Regulation in Canada," a paper prepared for the Conference on Competition and Technological Change: The Impact on Telecommunications Policy and Regulation, Toronto, 25-26 September 1984, (Mimeographed.), p. 26.

(5)Telecom Canada is an unincorporated association of the largest telephone company operating in each province and Telesat Canada. Formed in 1928, its objective is to develop and maintain a Canadian transcontinental network. It owns no equipment and has no permanent employees but relies on its member companies for both. It also functions to allocate, among its members, revenues generated by long distance services.

(6) Longnet plans to extend its services to

the Toronto and Montreal markets by the end of 1985. Moreover, it also expects to provide international service, in addition to its U.S. destinations.

(7) "Is deregulation catching?" Connections, World Communications Report 9(4 June 1984), p. 5.

(8) T.L. McPhail, "Interactive Cable Connection Services: The Duplex Society Problem", Canadian Journal of Communications 4:4 (Spring, 1978): 1-7.

(9) "Divestiture One Year Later: It's Not Working", Access (November/December 1984): 1,14.

(10) For a more detailed explanation of Canada's telecommunication regulatory structure, see: T.L. McPhail and B.M. McPhail, Telecom 2000, Canada's Telecommunications Future, (Calgary: University of Calgary, Graduate Programme in Communications Studies, 1985), pp. 40-41.

(11) W.T. Stanbury and F. Thompson, Regulatory Reform in Canada (Montreal: I.R.P.R., 1982), p. 57.

(12) Eldon D. Thompson, "Competition in Provision of Communication Services", in Proceedings of Communication in the 80's: Major Issues, eds. T. McPhail & S. Hamilton (Calgary: University of Calgary, 1984), p. 32.

(13) John F. Dealy, "Telecommunications: Policy Issues and Options for the 1980s", The Brookings Review 1:2 (Winter 1982):31.

(14) Masse, "Address", p. 19.

(15) Ibid., p. 29.

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A Five Year Telecommunications Planning Program for Alaska

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1. Abstract

In March 1985, the Alaska Senate Telecommunications Project asked the author to prepare a long term telecommunications plan for state funded services in Alaska. The paper reports on the basic framework for a five year planning program for furnishing a wide range of public services through telecommunications.

2. INTRODUCTION

For the past 15 years the State of Alaska has been developing systems for delivering education and health services via telecommunications. The impetus for this has been the widely scattered population structure of Alaska. The state's present population of 520,000 is spread over 1,530,700 sq. km. (591,004 sq. mi.) in 265 communities. Two thirds of the people are congregated in the three largest places; Anchorage, Fairbanks and Juneau, with Anchorage having almost half of the state's population.

In January 1985, the Alaska Senate Telecommunications Project began an examination of the state's role in developing future telecommunications systems. The need for state involvement in telecommunications development is more acute than in the rest of the United States because of Alaska's historic separation from the main currents of such development in other states. Until 1971, long distance telephone service was provided by the U.S. Army's Alaska Communications System. This system was then sold to RCA who set up Alascom as a separate regional subsidiary. Thus, Alaska was never a part of the Bell system prior to it's dismemberment under the deregulation policies now governing telecommunications services in the United States.

2.1 Effects of Deregulation on Alaskan Telecommunications Planning

At present the host of services spawned by deregulation are primarily aimed at serving major population centers and nationwide constituencies. Neither emphasis works in Alaska's favor because of the state's small market base and scattered population. While it shares this situation with some of the western states, the telecommunications situation is very different because Alaska is served primarily by a separate satellite system set up by Alascom. The only alternative for telephone at present is the service offered by General Communications, Inc. (GCI) to the expanded Anchorage area using the Anik satellites. Several satellites are accessed for television and radio feeds.

The above situation has some advantages since the state's telecommunications providers are forced to create systems uniquely designed to meet Alaska's regional needs. Whether most of these systems will be self supporting or whether they will require public assistance is the major question state policy makers must face.

2.2 Desired Level of Telecommunications Service

In addition to the fiscal problems, state policy makers must decide what level of telecommunications service is necessary and/or desireable for the state's future economic and social development. As a guide to policy development, four options for levels of service were presented to the Alaska Senate:

High Option - The state would vigorously encourage private services and provide a wide range of public services.

Medium Option - The state would encourage private services and make moderate improvements in existing public services.

Low Option - The state would exercise no role in promoting private services and discontinue development of public services.

Zero Option - The state would exercise no role in promoting public services and do nothing for private services.

The first three of the above options recognize that service will be provided by a mix of public and private services. The mix in Alaska is governed by the ability of the private sector to provide services to a small market base. Only a few of the major users; the federal government, the state government, major insurance companies and banks, and the energy based corporations with major holdings in Alaska's oil and gas development, have the size and financial strength to make notable impact on the decisions of private telecommunications providers. All others are dependent either upon the policies set by the deregulated private sector or by policies influenced by federal and state governments. The small Alaska market will always somewhat limit the amount of competition in telecommunications, which places a special burden on the governments concerned. Since federal policies must, by nature, be concerned primarily with federal concerns, the role of the State of Alaska is of far greater importance than in most states. Only Hawaii has similar problems of geographic isolation and size. However, the Hawaiian population is almost double that of Alaska which combined with its great influx of tourists creates a far larger market base.

2.3 Existing Public Financed Systems

In developing its future telecommunications policy, Alaska has the benefit of the lessons learned from three major public institutions engaged in delivering public services. The Learn/Alaska Instructional Telecommunications Network provides services from pre-school through university graduate courses to over 200 communities in the state at present. (1) The federal Public Health Service Network serves 120 rural health clinics throughout Alaska. (2) The Legislative Teleconferencing Network serves 67 places directly. (3) Learn/Alaska has been in operation since 1981 and there were ten years of delivery of educational services preceding it with audio conferencing beginning in 1971 and video delivery in 1975. The Public Health Service has used satellite based networks since 1971. The legislative net began in 1977. Thus, there is a substantial fund of knowledge and experience upon which to base any determinations for new services.

2.4 Proposed Five Year Planning Program

The above networks had to adjust their operations to existing systems in their early years. The long range development of telecommunications in Alaska should aim at influencing future satellite and other telecommunications developments as early in the planning process as possible. This calls for an assessment of public and private needs that will have credibility with those financing future telecommunications systems. The proposal for a five year program presented to the Alaska Senate thus focussed on an ongoing thorough assessment process in key areas of public service and a strong coordinating role in proposed private services. These assessments would be furnished to those with interests in future telecommunications development in the private sector and in the federal government.

In addition, state planners would work closely with local loop operators and long distance service providers to insure continued technological compatibility and system capabilities. Special attention would be paid to future satellite capabilities.

Finally, a continous close coordination with state and federal regulatory agencies would be maintained. In effect, the state planning effort serves as a prism through which the multitude of public and private efforts are focussed and retransmitted.

3.0 ASSESSING PUBLIC PROVIDED SERVICES

Five major areas of public service were initially defined for assessment in the five year planning program. These were based on the assumption that public services would continue to have a rural emphasis but would increasingly be available to urban populations. The other major planning assumption was that private services would follow a course similar to the rest of the United States in the three major urban areas of Alaska but might require some assistance for rural distribution, that assistance being primarily to insure that public services were delivered so as to facilitate private systems and not bypass them. In effect, public systems should whenever possible buttress the rural rate base rather than bypassing it. It may eventually develop that bypass systems are the most effective means of rural distribution overall, but this determination should be arrived at through evaluation and not through happenstance.

The major present policy fear in Alaska is that rural rates will escalate dramatically if deregulation results in a fragmentation of fiscal inputs to the system and that general telephone subscriber rates will be the chief victim of that escalation.

The five areas of public service defined thus far are: education, health, government, geographic and resource information, and community support services.

3.1 Education

Education is expected to be the major user of public telecommunications services in Alaska for the foreseeable future. The Alaska Department of Education found in a survey conducted in 1984 that 64% of the state's teachers were utilizing instructional television (ITV). Learn/Alaska provides ITV and audio conferencing now. Computer assisted instruction (CAI) is utilized by at least 80% of the teachers but planning for networking is just beginning.

Of Alaska's 100,000 primary and secondary students almost one quarter are in schools having less than ten teachers for both primary and secondary schools. About 10% are in schools having four teachers or less for all primary and secondary levels. The universities have about 27,000 total students, about half being full time.

A wide range of local materials in both ITV and CAI has been developed by the state, the universities and local school districts. The local programs combined with the wide range of national and international offerings available provides a great deal of flexibility for teachers in integrating materials into locally established curriculums.

The major asset that has been developed in Alaska over the past 15 years is a large and growing corps of classroom teachers and educational administrators who are experienced in ITV, CAI and audio conferencing. This was a slow growth until 1980 when the establishment of Learn/Alaska and the rapid introduction of microcomputers caused an exponential explosion of interest and utilization.

However, it is important to note that the very small cadres that were trained in early experiments and demonstrations were vital in creating the above situation. Without these cadres created by ATS-1 (1971-74), ATS-6 (1975-76), the Alaska Rural Television Demonstration Project (1977-81) and the Individualized Study by Technology Project (1977-84), it would have been impossible to train Alaska's teachers and, more important, to enthuse them into acceptance of the new methods.

Integration of ITV, CAI and audio conferencing into single course offerings is beginning now. Many believe this will have a dramatic effect on the effectiveness of distant delivered courses.

Teacher training in telecommunications applications still requires a good deal of attention. At present, a heavy in service training load must be maintained because of the lack of training in many universities, including those in Alaska. Bringing new teachers up to speed will continue to be problem until those who teach teachers are truly convinced of the value of telecommunications and computer technologies.

Finally, no formal evaluation of the effectiveness of Learn/Alaska as a delivery system has been undertaken, either of the whole or of the component parts. A good number of in house evaluations have been done and a reasonable data base exists from the past upon which to base an evaluation. Without this information, it is likely that priority allocations by administrators and legislators will continue to be accomplished without any particular methodology, or background to rely upon.

Another area that is not peculiar to education but fits here as well as elsewhere, is securing experimental budgets so that providers can obtain some hands on experience with new technologies. Alaska's original expertise was gained from monies provided by NASA and other federal agencies to do distant delivery experiments in audio, ITV and CAI. Thus far the State of Alaska has spent a tiny amount on videotext experiments but no regular experimental budget exists and the future does not appear bright on either the federal or the state scene.

In summation, the fate in the 1990s of Alaska's relatively mature distance education system relies upon its abilities to secure budgets for integrated course development, in service teacher training and applications experiments. It must also develop an evaluation mechanism that provides needed information to those who develop and pass on budgets. Finally, it must encourage the incorporation of more distant delivery training in teacher curriculums.

3.2 Health

Medical providers were among the first to give services through telecommunications in Alaska. Prior to the advent of satellite based services, blackouts of up to three weeks were common for voice communications between doctors and the paraprofessional health aides in small villages. The ATS-1 experiment showed a dramatic increase in system confidence due to increased communications reliability. This led to further experimentation on ATS-6 in 1975-76 transmitting electrocardiograms and heart sounds, using slow scan video for pictures of wounds and skin disturbances, and for transmitting xrays. Wide band video was also utilized for distant diagnostic experiments.

The service was regularized by the Public Health Service in 1976 as the State pf Alaska developed its rural small earth station network and 120 rural health clinics are now linked via dedicated audio conferencing channels to regional hospitals and the central federal medical complex in Anchorage.

The federal impetus in health experiments ended after ATS-6 and no funds have been available to expand the range of services offered beyond audio conferencing. The State of Alaska has made no effort to pursue any of the initiatives opened by the ATS-6 experiments. Happily, the North Slope Borough Health Department (serving 4,500 people spread over 215,000 sq. km.) is installing a system involving slow scan video, facsimile and computer databases to the health aides in seven villages from the regional center in Barrow. This system is not operational yet and no programmatic information is available. The University of Alaska is also exchanging medical information with the University of Washington medical school as a part of the Washington, Alaska, Montana, Idaho Medical Education Program (WAMI).

During a survey of federal research programs conducted by the author for the Alaska Council on Science and Technology in 1981, the Alaska Area Native Health Service identified the following areas of telecommunications delivery where further development was required:

automated medical records system
video presentation of patients from distant sites
remote electrocardiogram (EKG) transmissions
transmission of xrays by facsimile (4)

All of the above are possible with existing "state-of-the-art" and are being or will be accomplished by the North Slope Borough and/or the WAMI program.

The missing element in health delivery at the moment is deciding who will take the lead in determining whether any of the above services should be provided statewide in Alaska or whether they are simply extraneous "nice-to-haves" but not cost effective additions to the medical services for rural Alaska. So far such a decision has received no strong attention from senior policy makers. Hopefully, the North Slope Borough effort will spur the State of Alaska and the federal government to take the next step on a statewide program.

Another major problem that has received little attention is whether private medical services will be made available through telecommunications delivery. As in the rest of the United States most health delivery in Alaska is from private practioners and only Alaska Natives are entitled to public funded services from the federal government. Determining whether provision of private services through telecommunications is necessary and feasible should properly be the responsibility of the State of Alaska.

It may well be that the private sector has no need for distant delivery of any services and the present system of having patients fly to Anchorage, Fairbanks or Juneau to see the doctor will remain the preferred system. However, the system developed by the Alaska Area Native Health Service has shown that remote health care at several levels can be provided by telecommunications. It would seem that any future decisions on the role of the private sector should be made as a result of a detailed examination and not through a simple maintenance of the status quo.

In summation, a careful examination and evaluation of the North Slope Borough efforts will hopefully lead to the necessary federal/state/private coordination on what the next level of telecommunications delivery of health services in Alaska will be.

3.3 Government Participation

The Alaska Legislative Teleconferencing Network (LTN) has now been in operation for almost eight years. It was initially an effort to link together regional information offices in the larger cities and towns and make it possible for people willing to come to those offices to take part in legislative public hearings. It reached its peak in 1983 when it reached 67 sites, 45 of them connected by dedicated lines.

The LTN was conceived by the legislature and was evaluated annually on its perceived value to the legislature of that moment. For that reason no substantial evaluation record exists on how it contributed to the political process in a qualitative or quantitative sense. Considering its nature, a purely political evaluation is probably as good as any. In any case, the legislature cut the 1985 budget substantially from $3,577,500 to $3,270,000, an 8.6% reduction. The primary reason given was not clear other than a general feeling that is was not being used enough. (5)

Plans to expand public services through using the Legislative Computer Network have been cut back by the above reduction as have any efforts to try new technologies. Until a full independent audit of the LTN's effectiveness is accomplished, there is little reason to plan for any expanded services in any case.

Another element in the distribution of legislative information has been the televising of the proceedings of the Alaska Legislature now soon to begin its ninth year. This program has had a somewhat rocky road with great debate each year over its continuance. The House of Representatives bowed out one year leaving the Senate to occupy center stage alone.

Here again, system evaluation has been minimal. The author conducted a very short evaluation in 1982 which revealed that while the steady day to day viewing public was small, it was viewed intensively by those with a high interest in governmental affairs. A recent mail survey conducted for the 1985 session by Alaska Senator Tim Kelly indicated that 23% of the population view the programs and 45% felt the state should continue to fund legislative coverage by television.

In summation, the major problem for the LTN and its future is that no substantive research by political scientists, sociologists or politicians exists from which any determinations can be made as to the success or failure of the system.

3.4 Geographic and Resource Information

In 1977 the State/Federal Interagency Committee on Natural Resources Information Management (CONRIM) was established under the auspices of the Joint Federal/State Land Use Planning Commission for Alaska. Its task was to insure that data could be easily and efficiently interchanged between state and federal data systems dealing with land and resources.

For some time there has been discussion about making this information more widely available through a network serving all federal and state participants in the CONRIM and anyone else interested in participating. In November 1985 the Northern Information Networking Conference was held at which some 250 participants came together to plan the networking of their data information files. General agreement was reached on proceeding with such a network.

The Bureau of Land Management has an existing network based on Wang computers that is serving clients in rural Alaska. The Alaska Department of Natural Resources Division of Technical Services has an extensive digitized mapping program whereby parcels of almost any size with their attendant resource values can be displayed. It hopes to make this information available throughout the state beginning with the 10 land recorder offices maintained by the state. The North Slope Borough has a similar program which it plans to network to all its communities. Thus, a strong base exists from which to proceed once institutional agreements are reached. These are never easy to achieve but eight years of experience working together in CONRIM should smooth the way.

Hopefully, this important segment of the future public services to be offered in Alaska is well launched and on its way.

3.5 Community Support Services

Alaska state agencies supply a wide range of support services to the state's isolated small communities; primarily through the Departments of Community and Regional Affairs, Transportation and Public Facilities, Education, Health and Social Services, Public Safety and Environmental Conservation. The state's other 10 departments also provide a more limited range of services. Only the Department of Education has a well established telecommunications delivery system, as discussed under 3.1 Education.

Most services have been provided through travelling personnel, an expensive and cumbersome process that loses great amounts of time waiting at remote airports. Of Alaska's communities only 25 are large enough to support any level of professional support services. The other 240 must make do with occassional visits from travelling personnel, whatever consulting services they can afford and whatever information can be obtained on the telephone.

These communities primarily require engineering and maintenance services for buildings, water, sewer, roads and airports, financial management, administrative services and project management. The success of the health aides and the rural teachers shows that telecommunications support can directly improve services.

It is simple enough to design networks and software to provide the above services. The main problem is in training the existing bureaucracy in how to provide distant services. Past experience with educators and health professionals indicates that this is any area where adequate training funds at the right time is absolutely essential. Otherwise, if the transition period is delayed too long through underfunding, the forces against change will gradually have their way in either destroying or badly compromising inovation.

A strong executive mandate and adequate transition funding is the most effective means of insuring that new networks will begin to provide service and meet in a timely manner the expectations that have been raised among system users.

4.0 INTEGRATION WITH PRIVATE SERVICES

It is probable that private networking services in Alaska will follow the path that has occurred thus far under deregulation, where the Anchorage market has competitive long distance service and a generally complete range of telecommunications offerings that have not been extended elsewhere in the state. If it is to be state policy that all of Alaska should have reasonable access to the same range of services available to the urban sectors in the United States, then two critical tasks need to be done in the near future:

Determine what services private providers hope to make available in the next decade.

Determine whether these services will be affordable and available statewide or only in the major urban areas.

Much of what can be accomplished at this time will be somewhat speculative due to the pace of technological and applications inovation; and because of the uncertain economic patterns existing under deregulation.

At present, value added service networks (VANS) in Alaska are limited to Alascom Alaskanet and Online. Many Alaskans also dial directly into national VANS such as Telenet and Tymnet.

Whether private VANS in the future consist of continued refinements of microcomputer networking or whether they follow a videotext format is a critical element in the planning process, in which the path taken by public networks will be a strong determinant. Equally critical will be whether many of the VANS are provided through bypass systems, including the total bypass networks that may be possible using mobile satellites.

If public services are offered through bypass networks, it will be difficult for the private sector not to follow suit. State planners will have to combine economic expertise with technological knowledge to achieve optimization of the total delivery system.

5.0 PLANNING OF FUTURE TECHNOLOGIES

Future satellite capacity and the ability to access satellites from small earth stations will continue to be a key element for long range telecommunications planning in Alaska. Much is expected of mobile satellites in filling niches in the overall range of telecommunications services. Generally, those proposals before the Federal Communications Commission based on three satellites serving North America offer the most utility to Alaska.

Plans for small six transponder satellites are also of interest to the state. This would enable a focussing of Alaskan needs that is not possible with larger satellites designed for national systems. It would, in particular, offer the possibility of the best orbital position for serving the state.

The incorporation of local area networks (LANs) and integrated service digital networks (ISDNs) into the local loop services will require a good deal of retrofitting in both urban and rural areas. Here again, careful integration of the needs of public and private networks is a crucial part of the planning process for Alaska.

6.0 SUMMATION

It is likely that in Alaska, as in many other parts of the world, there will be a rapid growth of special purpose networks in both public and private sectors. In a highly competitive industry sophisticated users who can afford telecommunications planning staffs and consultants will generally do very well. General users may often be left out due to economic and technical constraints. Government telecommunications policy makers have in many ways a much more difficult role to play under deregulation than in the past. Now, public equity must often be achieved through direction of market forces by public budget inputs rather than by direct regulation. This is especially critical in areas like Alaska where markets will continue to be small and widely dispersed.

Government policy makers must always remember that there is no point in living in the information age if you can't be a participant. Those who cannot substantially participate, for whatever reason will be disaffected members of society to some degree. Providing traditional public services through information systems based on telecommunications delivery is one path to social equity in the information age.

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Point to Multipoint Microwave Subscriber Radio

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1. Abstract

Rural customers in many parts of the world are now being provided with telephone service by means of a point to multipoint microwave radio system which is called SR100. A new system with a greater capacity, SR500, is now operational in Canada, carrying voice and data traffic.

This paper discusses the advantages of point to multipoint radio over conventional service techniques, especially in developing rural areas. It describes the new system which uses demand assignment, time division multiple access (TDMA), to provide service to over 500 subscribers with efficient spectrum utilization.

It outlines a variety of applications of the system for new or replacement services, for voice, or for data aquisition and control purposes.

2. General

Point to multipoint microwave radio was developed in Canada in the mid 1970's in response to a request from a telephone company in Western Canada. (1) Its defined requirement was for a radio system that provided an urban quality service at a cost lower than the conventional wire techniques. The area to be served was a section of northern Saskatchewan where residents were scattered into small groups from 50 to 150 km apart. The land was rough, rocky, and heavily forested with few roads. Access was mainly by aircraft and over roads that are created in the winter by clearing paths on the ice over lakes and rivers. The telephone company had to overcome the problem of the high cost of placing cable or wire, and the high maintenance of the plant once it was built.

Radio was recognized to be the best practical solution at that time, and continues to be a first choice in such a situation. A Central Station can be placed in a town in the Central Office, and Outstations are placed at or near the location to be served. There is no outside plant to be built or maintained between the two, and service can be provided much faster and at any time of the year. In Saskatchewan it is impractical to place pole lines or cables at certain times of the year. Having determined that radio would solve the problem, the next consideration was the type of radio.

2.1 HF Systems 2-30 MHz

The first alternative to be examined is HF radio. These systems have long been used to provide communications to remote locations and are still the least cost solution where distances exceed a hundred kilometers for a single circuit. The limited spectrum in 2-30 MHz and the requirement for changing frequencies to select one with suitable propagation at various times of day, results in very crowded conditions and makes it impossible to guarantee complete freedom from interference. In addition, availability of the circuit can seldom exceed 95%. Nevertheless these systems are still very useful and sometimes they are the only possible solution.

2.2 Systems Using VHF/UHF 30-500 MHz

VHF single channel per carrier systems are the next consideration. Historically the VHF frequencies ranging from 30 MHz to 500 MHz have proven to be eminently suitable for development of mobile radio communications. These are now widely used in every country of the world for this purpose and have given rise to the availability of a very wide selection of volume produced equipment from the world's manufacturers.

Because of the general availability of this equipment and its ease of use, it is quite natural that this same equipment would find its way into service for fixed telephone subscriber circuits in isolated and hard to serve locations, and a number of manufacturers have produced systems based on IMTS (Improved Mobile Telephone Systems) technology. These systems offered better utilization of the RF channels through frequency switching in the subscriber end transmitter-receivers. One difficulty with the technology is that the system can offer only one circuit per transmitter-receiver and where a second circuit is required, the full complement of equipment must be duplicated.

In fact, some administrations have based their projects for rural service on this technology and have made extensive investments using it. In general, these investments have not withstood the test of time and have not provided an adequate level of performance to bring these rural subscribers fully into the world's telephone network with its stringent requirements.

Based on reports from telephone engineers around the world, there are a number of likely reasons for this. Equipment for general industrial mobile use has components and quality designed for a shorter service life than that of a fixed telephone network where 15 to 20 years is a minimum. Often the equipment has a number of adjustments to compensate for stability fluctuations, or it may require maintenance adjustments. This is not practical in a rural territory where equipment must operate reliably without skilled craftsmen being available. Where good equipment was specified and provided, capacity problems were soon apparent because of lack of frequency spectrum to grow. Our experience is based on situations where point to multipoint microwave radio has been a replacement vehicle for such systems.

In general, it is suggested that frequency bands so useful for mobile communications should not be considered for extensive fixed subscriber radio development simply because of the inevitable and high rate of growth of mobile communications. This limits the amount of clear spectrum which could be made available and therefore the orderly growth of Subscriber Radio systems.

Certainly no telephone administration has ever installed a system of any kind which did not need to grow.

It is for these reasons that when we built SR100, we looked for a relatively clean frequency band in the low microwave frequencies with sufficient spectrum to permit orderly growth to serve thousands of subscribers in any specific area. We seriously considered the 800 MHz region, but this band was also seen as the only available band still useful for mobile communications and likely to be needed within a few years for expansion of mobile radio. The recent developments in Cellular Mobile Radio and Mobile-Satellite communications have proven the worth of this consideration and captured the attention of the world's mobile radio manufacturers.

In conjunction with the Government of Canada, Department of Communications, we selected the 1500 MHz band for our development and this choice has since been acknowledged in the recommendations of the CCIR. Currently all manufacturers of TDMA rural subscriber equipment produce equipment for this band. SR Telecom now produces the SR100 system in all applicable bands from 1500 MHz to 2500 MHz.

This band has advantages in the area of good antenna gains at low cost, good propagation characteristics, and sufficient available spectrum to serve a sizeable land area.

3. System Principles

The usual configuration for a point to multipoint microwave system uses an omnidirectional antenna at the Central Station, therefore permitting access to Outstations in any direction. The Outstations can be placed near the subscriber, thereby minimizing the amount of outside plant to be used to reach the telephone set or terminal equipment (Fig. 1).

In order to make sufficient use of the spectrum, TDMA principles are used. Trunks are made available on a demand basis, being assigned only when a communication link is required between the Central Station and the Outstation. All trunks are available to all lines. The traffic capacity of the system is dependent upon the number of trunks that are available as well as the calling habits of the subscribers and, in the final analysis, the service objectives of the administration. In the SR100, 15 trunks are provided, permitting 8.1 Erlangs of traffic (P.01), serving up to 94 lines. The new system, SR500, has 60 trunks which will carry 47 Erlangs of traffic, (P.01), and serves more than 500 lines. It can be seen that a trunk group four times larger has about six times the capacity. Conversely, fewer than 15 trunks would be quite limited in their service capability.

The first system to be developed, SR100, consists of a rack mounted Central Station which can handle equipment for 94 lines, with an optional standby radio, and a series of Outstation configurations. The most commonly used Outstation is capable of handling six lines, with all radio and line equipment housed in a compact, sealed cabinet. The cabinet is designed for outdoor mounting and can accommodate any climate, in spite of extremes of temperature and humidity. This same cabinet, now time tested, is the basic cabinet of the SR500. Other Outstation configurations are available to accommodate more than six lines, with a rack mounted arrangement to serve up to the full 94 line capacity.

In order to meet the requirements of a thinly developed territory, a synchronous repeater is used to extend the range of the system. The Repeater is housed in the same weatherproof cabinet, and with its low power consumption, can be solar powered. Based on experienced, a typical system handles the telephone traffic in a rural territory with one or two radio hops, however coverage can be extended to 100 to 175 kilometers with a system using four or five hops.

4. SR500

In the course of our meetings with planning engineers in various telephone administrations, it has been identified that in some cases it would be very useful to offer a system which would collect the traffic from greatly extended rural areas into one switching centre located within a city. In order to do this, we would need to provide a system with much greater capacity and also incorporate a capability for long distance transmission in order to reach the borders of the much larger area. Also within the much larger serving area of such a system, we would expect to find some secondary population centres (towns, in the scale of villages, towns, and cities) where a need exists to serve 100 or more subscriber lines from one equipment centre.

These factors have given rise to the design requirement for our new SR500 system. It operates in the same frequency band, with the same general configuration, Central Station and Outstations.

As indicated earlier, the SR500 system has the capacity to carry about 47 Erlangs of traffic (P.01) using a large trunk group of 60 full availability trunks. Each trunk in this configuration is a 64 Kbit/s PCM channel, and the transmission medium is digital radio. This provides the

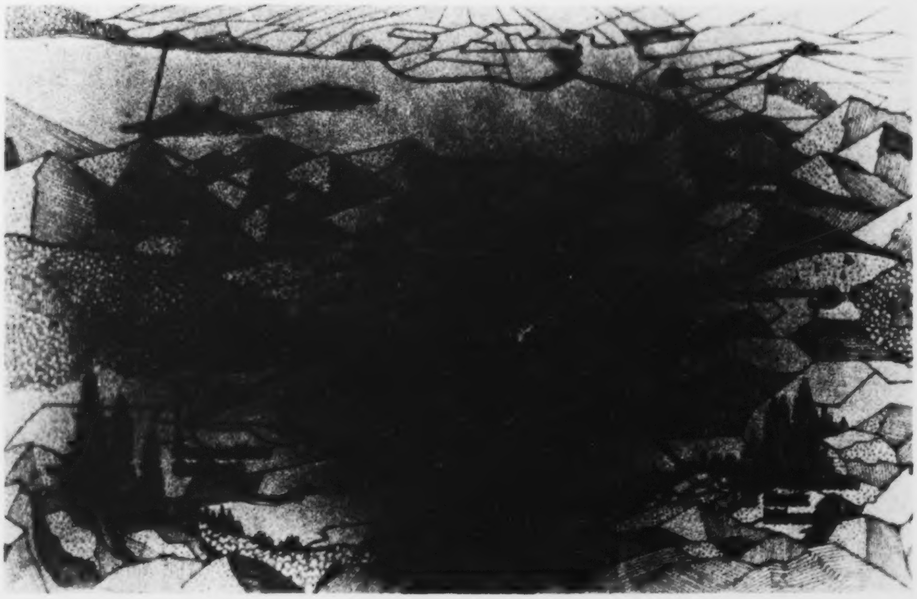

Fig. 1 Pictorial of point to multipoint microwave system showing Central Station, Outstations, and Repeaters.

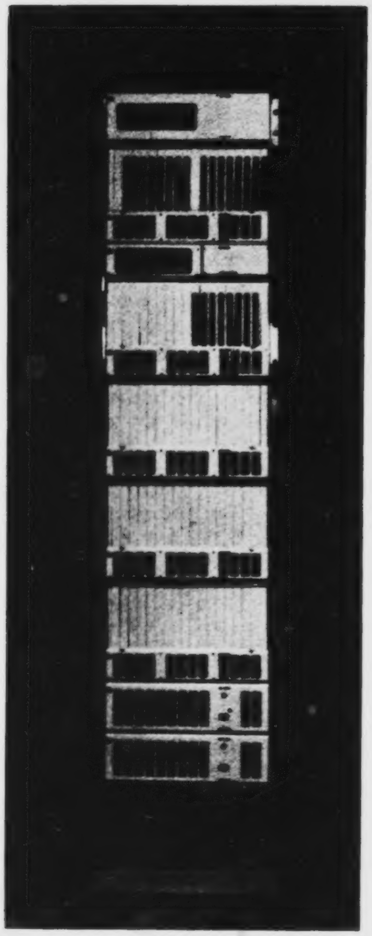

Fig. 2 SR500 Central Station equipment rack, equipped for 192 lines.

intrinsic capability of unlimited repeating with regeneration for the required long distance transmission. Other factors within the system, however, limit our maximum transmission range to 1000 kilometres. The system will be offered in the same frequency bands and RF channel spacing as the SR100 system.

We have provided for the larger wire centres by considering the strong community of interest which will exist at these locations by enabling local traffic to be connected wholly within the local equipment without any occupation of system trunks. All dialling, signalling and supervision of such local traffic is routed to the Central Office using the system's common signalling channel. Thus the main switching centre (and the network) will be kept fully aware of all user traffic for call metering and external call attempts. Since the existence of such centres will generate a considerable amount of traffic without using system trunk capacity, we have made provision in the system to accommodate and supervise up to 4096 total connected lines.

Of course there are many other features and details to be considered in this system. The system is fully supervised and alarm monitored at all times; provision is made to bar delinquent subscribers in the furthest corners of the system from a terminal console at the switching centre; classes of service can be varied in the same way; data capabilities are built into the system to handle the customer requirements from low bit rates up to 64 Kbit/s, per circuit; and there is no practical limitation on the number of nodes or Outstations which can be equipped in a single system.

The equipment is compact, with the Central Station occupying part of one vertical frame in a telephone Central Office (Fig. 2). At the top of the rack is a compact transmitter-receiver with displays of status and alarms. This unit incorporates a modulation scheme which is cost effective, with high detection performance, and narrow transmitted RF spectrum. It meets the requirements of efficient bandwidth utilization and low power consumption.

Below the radio is a shelf containing line units which, at eight lines per module on a two-wire basis, provide for 128 lines. Data services or four-wire E & M services occupy two per module. For each set of line modules there is one shelf interface module.

The next panel contains a display for the controller which has a complete menu of traffic and alarm information for the system. A printer is available on the same panel to provide hard copy of this information where required. Ports are also available for monitoring the system at a local data terminal or for access from a remote location such as a test or control centre, or from an Outstation. This shelf also contains the control and interface circuitry.

Below this, in addition to line modules for 64 lines, are modules performing the functions of control, multiplexing, framing, common channel, timing and intracall. The system has complete redundancy of the central processor in a hot standby mode, or where required, all common equipment. With the failure of any unit of common equipment, all operations continue with no lost traffic or interruption of service.

The rest of the Central Station's rack has space for additional lines at 128 per shelf. At the bottom are the two power supplies, one for the radio and one for the controller and interfaces.

4.2 SR500 Outstation

The Outstation, which has a capacity to handle 16 telephone lines, is housed in the identical cabinet that is used for the SR100, meeting the same environmental standards (Fig. 3). It has a thermal syphon on top of the cabinet for heat dispersion at warmer temperatures. The horizontal modules in the upper portion perform the functions of framing, timing, multiplexing, common channel, and control. The unit on the left is the power supply which provides all necessary voltages for the equipment. The radio is at the rear of the cabinet, and it operates in a burst mode, using a very efficient modulation technique.(2) Low power consumption is particularly important when solar power is used at an Outstation.

A separate unit, not shown, is a small cabinet mounted near the Outstation, which houses the line connections, gas tube protectors, and standby batteries. It also contains a unit to convert commercial power to 24 or 48 VDC.

Alarm features are available to identify problems in the Central Station and in any of the Outstations. In addition, it has been recognized that telephone administrations have been particularly interested in identifying problems in the customer loop, between the Outstation and the telephone set. A test feature permits remote examination of the loop for shorts, opens, grounds, and for the presence of foreign voltages. This will permit the administration to dispatch the appropriate craftsman to make the necessary repairs.

4.3 The Maitland Commission

The Maitland Commission, in the report "The Missing Link", recommended that manufacturers and operators be encouraged to develop systems, using the latest technologies where appropriate, which will enable the needs of the more remote areas of developing countries to be met at lower costs. SR500 fits this definition precisely as does the SR100. The latest technology has been utilized, and moreover, it meets the needs of the remote areas. (3)

Installation and repair of Outstations is simplified to avoid the need for the type of skills required for the microwave systems used for interoffice trunk systems. The Outstation is installed using simple tools and, with the application of power and orientation of the antenna, is ready to carry traffic. Timing of the Outstation transmission, which is a function of the distance to the Central Station, is performed automatically. Repair is limited to the direct replacement of modules, or more simply the complete unit, which can be returned to a central location for repair. Experience with the SR100 has given a proven performance of over 14 years mean time between failures.

The Maitland Commission report also recommends an efficient use of the radio spectrum. The system operates at well over 1 bit per Hertz, and this efficiency is multiplied when the impact of TDMA is considered, thereby meeting the principles of the recommendations.

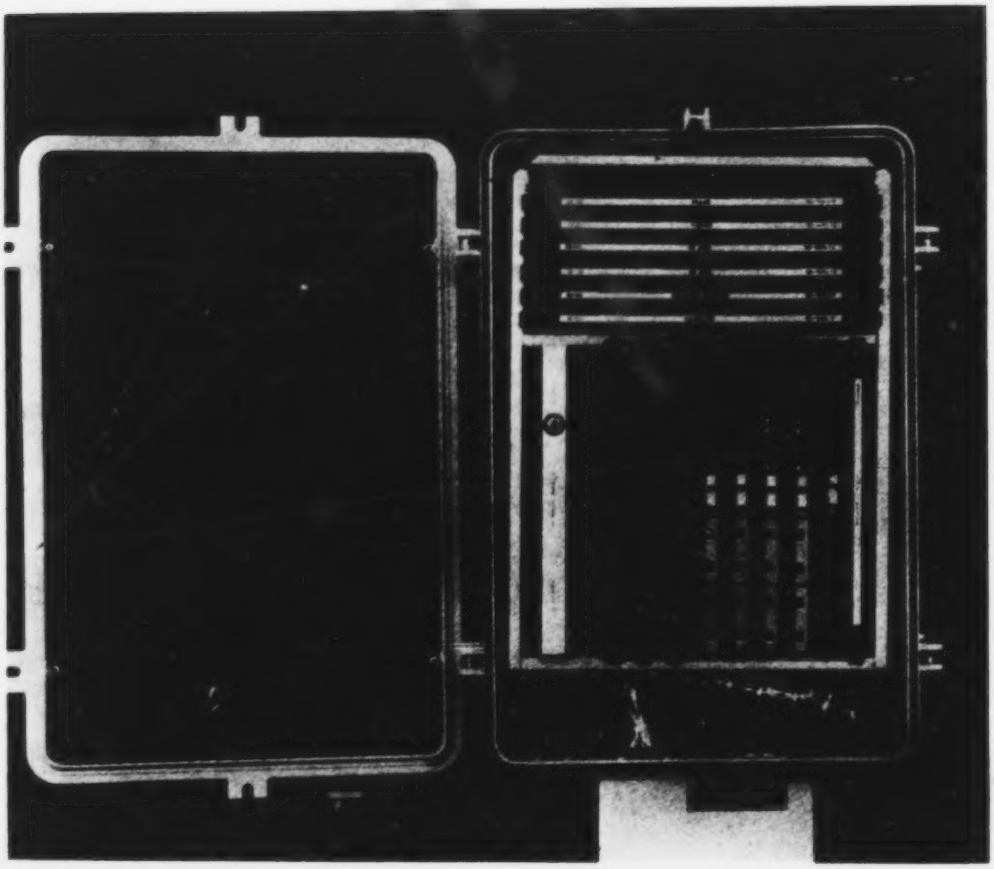

Fig. 3 SR500 Outstation equipped for 8 subscriber loops, 3 data lines, and 2 lines of 4-wire E & M.

CCIR documents recognize both 2 MHz spacing and 3.5 MHz spacing for systems of this nature. We have chosen 3.5 MHz for two reasons. Practically all of the world's systems in service today operate on this frequency plan. This permits introduction of SR500 without conflict. Secondly, the larger bandwidth permits a greater number of trunks, and, as discussed previously, the greater traffic capacity results in a much higher utilization of the total band.

5. Application

Of the many applications for the new system, the most obvious is for rural telephone service in a widespread area. As indicated earlier, with the use of Repeaters, a large area can be served, and with digital regeneration there is no limit on the number of Repeaters in tandem. The system starts to prove in over SR100 at about 200 lines. The two types of systems can be mixed within the same region, however they must operate independently. Some administrations have decided that when growth exhausts the capacity of existing systems, a replacement program will provide for expansion and free them for areas with a lighter telephone development.

Where the six line cabinet size of the SR100 proved to be ideal for villages where an average between three and four lines were required, it is anticipated that the 16 line cabinet will prove to be ideally suited to larger communities. It also permits initial installations with a small number of lines, at the same time permitting capacity for future growth with the simple addition of loop modules as required. This is one of the advantages of a radio system over copper line systems where the capital commitment must be made initially, whether or not the growth materializes.

Data and telephony can be mixed on a system, and it is possible to dedicate channels where required. This leads to a plan which is open ended. Telephony is provided initially and at a later date, when special services such as high speed data are required, the capability will exist.

In many cities in recent years, government departments have expressed a need for private networks for voice and data. This need has been met with SR100 with data speeds up to 9.6 Kbit/s. It is possible with SR500 to create a network within a city with data speeds up to 64 Kbit/s, with a mix of many speeds, some dedicated and some demand assigned. The needs of banks and other multi-terminal private networks can be met by establishing a dedicated computer polling network.

Security networks are another example. By its nature, the system is one which is practically immune from monitoring. The reason for this is that all Outstation transmissions are timed so that their signal arrives at the Central Station in a precise time slot. It follows that at any other location these signals will interfere with each other and will not be detectable.

In addition to central polling of computers, networks can be created for Systems Control and Data Aquisition - as would apply to power and gas utilities. It is particularly applicable to offshore oil platforms where radio is the only solution.

Another application is for ground distribution about a satellite earth station. Where satellite links are used to reach extremely remote areas there will seldom be a ground distribution network already in place. Point to multipoint radio can easily be that link.

In the past, resource exploration companies have needed communication links that are in a fixed location for short periods. This has been accommodated by placing an Outstation or Repeater in a vehicle with an antenna which can be deployed quickly and easily in each new location, and relocated just as easily.

This paper has addressed only some of the applications for point to multipoint. Other applications are awaiting the needs and imagination of telephone engineers. Some of these will almost certainly utilize the capability of dedicating channels as trunks and using the remaining capacity for subscriber loops.

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The South Pacific Telecommunications Development Programme

Progress Report

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1. Abstract

The paper discusses the background to the establishment of the South Pacific Telecommunications Development Programme with its unusual management arrangements. Reviews of the technological issues being studied, likely costs and duration of the programme are also provided.

2. GENERAL

One of the decisions of the October 1983 Forum Meeting of the Heads of State of the independent countries of the South Pacific was the establishment of the South Pacific Telecommunications Development Programme (SPTDP) which represented a unique step in regional co-operation to foster telecommunications development.

The Forum decision was the culmination of extensive consultation between the participating countries and with Australia and New Zealand which was co-ordinated by the Fiji based South Pacific Bureau for Economic Co-operation (SPEC). The consultation included the preparation of the SPEC Rural Telecommunications Study of the South Pacific which was undertaken by three experts from Australia and New Zealand using funds contributed by the two countries. The Rural Telecommunications Study was completed in September 1982 and has recently been updated and published by SPEC with the title SPTDP Planning Report.

Reflected in the adoption of the arrangements proposed for the SPTDP was the clear recognition on the part of the island country members of the South Pacific Forum of the value of regional co-operative endeavour in the telecommunications sector. Both the smaller and the larger island countries are working together through the Programme to ensure that the benefits of modern telecommunications technology will be available to all in a coordinated and cost effective way.

The Programme is progressing on the principle of self help, regional co-operation and effective utilization of external assistance. Coordinated planning, standardization and bulk ordering of equipment are examples of the way in which both the inputs of the participating countries and the resources provided by the aid donors are to be put to the most effective use. National inputs signifying Governmental commitment to the Programme will require substantial supplementation from external sources if modern systems of telecommunications are to be provided to all of the scattered regions of the South Pacific within the next decade.

Responsibility for overall co-ordination, implementation, and reporting to the South Pacific Forum Heads of Government rests with SPEC which has established a small telecommunications management and engineering group in Suva led by a Programme Controller. The telecommunications planning and associated work of the Programme Controller is directed by a Management Group, comprising members from each of the participating countries and from Australia and New Zealand, which meets at regular intervals. Five meetings have been held during 1984 and 1985. Major policy responsibility rests with the South Pacific Forum through the Director of SPEC. Funds to cover the costs of the Programme Controller's office and of the Management Group are being provided by Australia and New Zealand.

3. THE PROGRAMME

An important feature of the Programme is that it is being jointly managed by the Governments of all the South Pacific Forum island countries, in association with Australia and New Zealand, namely:-

Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu, Western Samoa.

The Forum governments have also agreed to grant observer status to non Forum Pacific island countries interested in taking part in the discussions of the Management Group. American Samoa and Marshall Islands and Palau have recently joined the meetings on this basis.

The Programme's main objective is the provision of reliable telecommunications to villages in the South Pacific Forum countries in order to strengthen the economic and social integration of rural and urban sectors.

Based on the preliminary survey in 1982/83, the provision of the rural sector elements of the programme was expected to span a period of at least ten years and involve expenditure of at least $US120M. At the meetings of the Management Group, countries have noted the importance of providing increased urban sector facilities to interwork with the new or expanded rural sector. Some small island countries have made the important point that their networks cannot be separated into rural and urban sectors.

Funds for the Programme are being sought progressively against a rolling three year programme. The first of these programmes covering the years 1985, 1986, 1987 which was endorsed by the participating countries at a meeting in Rarotonga, Cook Islands, early in November 1984, totalled approximately $US90M. At this rate, the 10 year expenditure can be expected to be close to $US300M compared with the earlier estimate of $US120M. Within the $US90M total for the first three year programme, some $US40M was expected to be provided by the countries from internal fund sources and the balance to be sought elsewhere.

Successful completion of the Programme will require the use of the most advanced telecommunications technologies, including radio transmissions through geostationary satellites, digital modulation of radio and cable channels for trunk and subscriber services, and the use of stored programme control automatic telephone, telegraph, and data switching systems.

At its 1985 meeting in the Cook Islands, the Forum directed that the Management Group include the possible integration of television transmission with general telecommunications within its SPTDP planning and report on this work to future Forum meetings.

4. TELECOMMUNICATIONS DEMAND

The starting point in progressing the Programme is a system of infrastructures which are inadequate and in many cases outmoded. The traffic densities are extremely low within the existing networks and may be even lower within the proposed extensions. Some countries have orders for new subscribers which cannot be fulfilled until cable or switching systems are extended. There is some evidence that in other countries the lack of deferred applicants results from dissatisfaction with the standard of service provided by outmoded non automatic services.

Despite the evidence to the contrary (and particularly the recommendations of the recent I.T.U. Report of the Independent Commission for World Wide Telecommunications Development, "the Maitland Report"), there are many examples of the lack of appreciation by business and even government interests of the value of appropriate use of telecommunications to assist economic growth in developing countries of the South Pacific. Telex and data traffic is quite low, due again to the lack of appreciation of the value of non voice communications as an important adjunct to business and government administration. With the archipelagic nature of the island nations and difficulty in ensuring regular mail deliveries by sea or air, a compelling case can be made of the greater use of electronic delivery of the written message - not just for business but, on grounds of common humanity, for the delivery of private correspondence by simple electronic mail systems!

An unusual feature of the total telecommunications traffic in the South Pacific is the very high percentage of telephone calls (both originating and terminating) which are international calls; particularly to New Zealand and Australia. This is to be expected as most of the import and export trade as well as tourist activity within the South Pacific flows between Australia and New Zealand on the one hand and the island countries on the other. Many South Pacific family members temporarily or permanently resident in New Zealand or Australia and regular calls are made between the family members.

The end goal of the Programme must therefore be the provision of infrastructures for national and international traffic which will permit the present telephone and future associated telex and data signals to be distributed in accordance with the needs of government, business and the public. In the case of the planning of satellite systems for national and international services, there is an important need to also take account of the future needs for the distribution of television programmes.

5. THE TECHNOLOGY

Despite the low traffic density and small size of the majority of the South Pacific telecommunications networks, there is no case to be made for the use of older technologies. Studies to date have confirmed that economic advantages (in capital and recurring costs) will accrue from the use of the most modern techniques e.g. stored programme control switching systems, digital transmission, satellite networks, solar and wind powered electric supply systems, passively cooled equipment shelters.

Perhaps the most important technological issue to be identified is the value of satellite transmissions for national and international traffic. With the very high ratio of water to land over the whole area and the difficulty of engineering traditional terrestrial transmission systems for trunk or subscribers circuits over long water paths, particularly if provision is to be made in the basic infrastructure for the later introduction of the "converged" data services, a regional satellite network can no longer be regarded as merely desirable but must be accepted as necessary.

Brief comment on the elements of the systems which are being currently planned within the SPTDP follows:

5.1 Transmission Systems

As mentioned previously, satellite connections become a necessity if provision is to be made for the expected level of increase in not only telephone traffic, but for all of the associated telecommunication traffic including television distribution. With the intended use of digital switching systems and the general use of digital transmission methods for non satellite circuits, a good case can be made for the use of digital transmission on the satellite circuits. To effect economies in transponder usage, particularly in the cases of low traffic density, demand assigned multiple access (DAMA) methods of channel sharing are to be utilized, including the more recent digitally encoded methods.

A special issue which arises in planning satellite services for the South Pacific "Micro States", with low telecommunications traffic and small economies, is the importance of ensuring that both domestic and international traffic is carried through the same space segment, thus eliminating the need for separate national and international earth terminals or even of separate antennas. Consideration is also being given in the Programme Controller's study of the "satellite option" to the economic comparison of a regional satellite service which combines "within country" and "within region" traffic (allowing traffic to countries out of the region to use Intelsat) with the more traditional service where traffic within the region is regarded as "international" and uses the Intelsat network for connections even between countries in close proximity to each other. Both of these concepts raise "institutional" issues between international and national common carriers and between Intelsat members or users and the Intelsat consortium. The case for breaking down traditional barriers will depend upon the size of the economic advantage to be gained by a change.

Some reservations exist regarding the use of 12/14 GHz systems in the South Pacific (or elsewhere - in the view of some authorities!) and measurements and experience of rain attenuation in the region are urgently needed. The more optimistic view is that with the existence of "blue sky" conditions for the majority of the time in the South Pacific, it should not be difficult to make adequate provision within link budgets for the occasional attenuation of uplink and downlink signals by rain.

Although satellite connections will be necessary for the longer sea paths, trunk and junction circuits will also be provided over terrestrial radio paths within the larger islands and across the shorter sea paths. In many countries, a case can also be made for the use of radio connections to subscribers. World wide adoption of cellular radio systems to provide network connected mobile radio telephone services has led to the availability of low cost transceivers for installation in motor vehicles. This same transceiver is also becoming available for use as a subscriber terminal for non mobile applications. In the island countries, where radio spectrum limitations are not a serious problem, a simple radio subscribers network often provides a cheaper solution than cable or open wire line construction for subscriber connections.

5.2 Exchange Equipment

The use of stored programme control electronic switching system for all new exchange installations, and in some cases to replace existing electro mechanical systems where a cost advantage can be shown for the replacement, has been accepted by the participating countries. Not the least of the advantages available from the introduction of the electronic switching systems, is the large saving in skilled staff needed to operate and maintain the highly reliable, largely "hands off" modern SPC switching facility. An unusual feature of the planning for the switching systems is the expected need for large numbers of "stand alone" SPC systems of very small line capacity (50-500 lines).

5.3 Miscellaneous

The planning of the extended and improved services in the South Pacific has focussed attention upon the need to give special attention to the design of equipment shelters (particularly to recent developments in passively cooled prefabricated shelters); to the use of modern integrated power systems which utilize alternative non fuel consuming solar and wind generation, and thus offer opportunities to reduce oil consumption by the generators used to charge batteries in the many locations where mains power is not available; to the design of standardized, easily erected, aerial support structures for the terrestrial radio relay systems.

6. CONCLUSIONS

There are earlier examples of regional or sub regional co-operation for the development of telecommunications infrastructures. The earliest of such initiatives were in the provision and operation of long distance submarine cables for international traffic.

Intelsat and Intersputnik are current models of global co-operation to provide international connections by satellite networks. The African States cooperated, with ITU assistance, to provide terrestrial radio relay systems across Africa with spurs to the North and South during the 1960's and 1970's. The Asian countries more recently collaborated in the establishment and operation of the PALAPA sub regional satellite network for national and international connections within and between their countries.

The point which must be made in connection with the S.P.T.D.P. is that it does not at this stage envisage point ownership or operation of any part of the telecommunications system. The co-operation is in the planning, technical specification, equipment procurement and funding activities from a single Management Group with equal representation from all island countries and with the bigger helping the smaller.

Help is also being offered or extended to the Programme, in cash and in kind, by national and international government authorities, private telecommunication organisations, equipment manufacturers, educational bodies and perhaps the most rewarding result of all, by interested individuals both within and outside of the Pacific.

For the present, attention can be drawn to the unique cooperative management arrangements being used and to the broad features of the S.P.T.D.P. As the cooperative management bears fruit, it will be possible to report worthwhile technical achievements as well as steady progress with its implementation.

The Morelos II Satellite System
Developmental Necessity or Political Expediency

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Abstract

The Mexican Morelos Satellite System has, without a doubt, become one of the most controversial topics in Mexico, the outcome of this controversy will formulate a model of development for other nations toying with the idea of acquiring their own satellite system. The controversy is a complex one, mixing developmental philosophies and their models, with political expediency, commercial exigencies and last but not least the inevitable reality that sets the context for any innovation.

The Morelos Satellite System (MSS hereafter) has had a chequered development in terms of what media planners and politicians in Mexico have considered to be necessary, expedient, appropiate, and feasable. At no stage of this history has it ever been crystal clear that Mexico actually needs an entire satellite system of its own, nor how the increase in capacity from the present four transponders currently rented, to the 22 channels per satellite made avaible, will be used. The project began as a logical outcome of Mexico's increasing use and participation in Telecommunications since its formal application for membership to Intelsat in 1966. The agreement with Intelsat was finally approved six years later, in 1971, even though the Nineteenth Olympics was broadcast by the ATS-6 NASA satellite under rent to Intelsat in October 1968.

The first earth station was built in September 1968 in Tulancingo, with two more antennas added by 1980. This has taken care of the international satellite traffic, particularly of major international events, the Olympics and the World Soccer Cup. National use of satellites began in 1981 with the renting of transponders from Intelsat. In October of 1984 Mexico is still using a minimal number of four transponders (1). Televisa is the major user with channel 2 using one transponder and channel 7 half another. State Television and Petróleos Mexicanos with telephony,use the remaining one and a half transponders. Televisa's Univisión uses the fourth transponder rented from Hughes' Galaxy I.

The earth stations forming the national telecommunications infrastructure (the country was divided into thirteen regions with the antennas being distributed accordingly) are as yet far from completed and the data varies according to the source. In March of 1983 the official version was that there will be a total of 227 stations of varying capacity of which about 171 are already built (2). Of these 171, 127 carry the signal of Televisa's channel 2 in 29 states, channel 5 uses 2 antennas in 2 states. State Television (Televisión de la República Mexicana) with low audiences in carried by 87 antennas throughout 29 states, and one antenna is used for Univisión.

This is the back-drop for the acquisition of the MSS. It must be made clear however, that the acquisition of the national satellite system supplying a total of 44 transponders must be seen in a context of actual use and of the conceptual development of the Morelos Satellite System. Mexico needs and uses telecommunications equipment, but it still rents only three transponders from Intelsat on a regular basis, the same number as in 1981, four years earlier. Thus, it is obvious that while Mexico needs access to satellite channels, it does not necessarily need to be a national one for at least another ten to fifteen years. The confusion that has accompained the acquisition of the Mexican Satellite System is highly indicative of the overall confusion confronting developing nations in terms of models to follow and how to know when one has arrived. A quick historical glance at developing nations over the last thirty years, one may observe the use of dubiously significant landmarks in the process of developing along the lines held dear to conventional development wisdom. A model developing nation would first ensure the construction of a capital city and an international airport, though not necessarily in that order. The next step consisted in the development and promotion of a national airlines that more often than not, must receive subsidies to survive. It seems now the next fashionable step is the acquisition of the national satellite system. Even though the development of a technical infrastructure sofisticated enough to ensure full use of such a system maybe well over a decade away. Added to which, the development of sufficient material to fill the available television channels will be an even more serious problem.

The notion of a national satellite system for Mexico has a rather hazy beginning. In October 1980 the Secretaría de Comunicaciones y Transportes (SCT) received the presidential approval to develop a satellite system for national use. A few days prior to this announcement, Televisa signed an agreement with SCT establishing that Televisa would build and equip 44 stations and then turn them over to SCT; who would handle the transmission of signals and the satellite, guaranteeing Televisa preferential access in the event of only one signal being carried. The location of the earth stations would be distributed in agreement with SCT (3).

In June 1981 the President authorized the project, then called Ilhuicahua, and in July 1982 Televisa and SCT signed an agreement for the adquisition of a direct broadcast satellite. At this point the contractor for the satellite system was as yet undecided. There was a certain amount of pressure for the acquisition of the satellite, as Mr. Azcárraga, president of Televisa stated: "If the satellite is not ordered within ninety days... it could happen that, when Mexico wanted to order one, it would not be ready by 1985 or 1986, perhaps not until 1990" (4). In October, a study being done to consider the variety of satellites avaible to Mexico was finished, and Hughes was awarded the contract with Televisa financing the project.

The satellite system contracted to Hughes was to consist of two satellites and a tracking, telemetry, and command station to operate the system. The satellites (5), a hybrid version of the HS 376 (each carrying 22 channels) are particulary suited for direct broadcast, a characteristic for which it was chosen. Earlier on in the year, there was a lot of discussion in favor of the use of a direct broadcast satellite and the adquisition of the HS 376 was therefore, consonant with this consensus. In November of 1982 the political machinery did an about face, a government official stated that the satellite would not be used for direct broadcast, it being technologically impossible at that time. He added that Televisa would no longer particulate financially in the acquisition of the satellite system (1).

In December 1982 the incoming De La Madrid regime passed a bill through Congress, modifying article 28 of the Political Constitution, adding communication via satelite to the other forms of broadcast under Government supervision. The name Ilhuicahua is changed to Morelos and the National Plan for Development (NPD), unveiled in May 1983, incorporated the satellite system into its charter ..."establishing the Morelos Satellite System and the necessary earth stations for the transmission of television, telephony and data" (1). This was followed by an extensive campaign promoting the notion of a state satellite system.

The NPD, in assessing the communication needs for the country, reached the following situation (6): The microwave system had attained saturation point during 1981, obliging the rental of three transponders by 1982, ten more for telephony by 1985, thirty four by 1990 and forty two by 1995. Currently however, Mexico is still using the three transponders rented from Intelsat four years ago. The plan states that the study for users and specific uses is far from complete even though the MSS life span will be half over when this study is finally completed. The official version for specific uses are understandably contradictory, given the state of the study. One moment SCT states that the microwave system will be used by telephony, television would be transmitted by satellite; shortly after it is declared that telephony will also be sent via satellite. The problem of direct broadcast is also unresolved, the HS 376 is, according to Hughes (7), particularly suited for direct broadcasting . When the Government announced a change in broadcast policy it did not seek a change of the satellite ordered nor its specifications, thus Mexico is buying a direct broadcast satellite when its official policy is one of earth station retransmission.

Another unresolved situation is the relationship between SCT and Televisa. Not one of the various accords have been annulled. On March 1984 Jiménez Espriu, Undersecretary of SCT was asked about his ministry's accord with Televisa. He replied (8): "...there is no agreement in existence with anyone, it(the Morelos System) is part pf the communications infrastructure of the Federal Government... there is no agreement with any company of any kind".

Of the 44 stations that Televisa was to build, forty have been built, but here the confusion concerning information about this whole affair sets in. According to one source (2) Televisa built twenty under terms of the 1982 agreement, canceling the rest verbally. Then went on to build ten outside the accord, in locations of Televisa's own choosing, totaling 32. Another version is that Televisa built forty earth stations and handed them over to SCT between June and July 1982. There is a further complication to this, Televisa claims a verbal pact with the López Portillo regime agreeing on the construction of a total of ninety five earth stations, of wich seventy eight have been finished. Forty two of these correspond to the September 1982 agreement and thirty six do not (1). Of the 78 built only 39 have SCT authorization to function, the other twenty are working clandestinely.

The agreement made in September 1982 between SCT and Televisa entailed the construction of forty four earth stations and delever them to SCT which would then make them publicly avaible for concessions, but the situation is perfectly clear, Tevisa has managed to build a fairly well distributed earth station infrastructure; the question of direct transmission as Televisa wanted it, was never changed. All this has been aided and abetted by SCT with the result that Televisa is perfectly ready for the satellite system while the Government (9), through SCT, is still trying to figure out the best ways to use the system. The fact that no cost-effective study is avaible, indeed if one ever existed, shows that the system has been poorly conceived. Mexico currently rents three transponders at 1.6 million dollars each from Intelsat which over ten years would amount to 48 million dollars. If twenty three transponders were rented at 36.8 millions annually, then at ten years the cost of 368 millions justifies, the present cost of 150 million dollars for the Morelos Satellite System (1). But the fact is that Mexico still rents only three transponders. The fourth, rented by Televisa belongs to Galaxy I, an American domestic satellite, possibly violating the agreement with Intelsat concerning domestic satellite use.

The claim to increased sovereignity, the strongest argument for the MSS, is somewhat offset by the fact that there is a very small telecommunications industry in Mexico, resulting in a poor infrastructure. Thus technological dependence will increase as equipment must be imported. Maintenance will, by admission of a high functionary, also be a problem; the courses given technicians both in Mexico and at Hughes' laboratories is of a push-button nature. And to date, there are no medium to long term plans for the development of such an infrastructure (10).

But perhaps, the biggest problem of all has yet to surface, what will fill the channels? Televisa and the big national and transnational corporations have the economic capacity to use the system but, what about Mexico? The Government has barely enough production to fill the 12.5 percent time slot used in lieu of taxes, much less fill two or three more channels; and it is increasingly doubtful that this will change. The massive foreign is strangling public spending, this not only affects the production capacity of the recently formed Instituto Mexicano de la Televisión, but it also affects the other institutions such as universities that could produce for the System.

The contraction of public spending will also slow down, if not halt, the distribution of necessary telecommunications equipment to complete the public sector's integration into the MSS (hospitals, clinics, schools are but a few of the list of 'possible' users cited by SCT). Added to which the necessary training of personnel to work such equipment is made difficult by the lack of a job market, caused by the same lack of equipment to work with. None of this is unsurmountable, it merely requires more time to develop than is made avaible by the life span of the satellite system.

The earthquake of September 19, severely damaged the existing telecommunications infrastructure particulary the Central Telecommunications Tower, the heart of the system, and it is forecast that it could take up to three and a half to four years to repair (11). As a result Mexico is placing the Morelos B in storage orbit, thereby extending the life span of the satellite system by four years.

The storage orbit for the second of the two Mexican satellites will prolong the expected life span of the Morelos System as it stands now. But just how damaged the earth telecommunication system is, has not been clear. SCT offcials admitted fully, damage caused by the earthquake (September 19), by November, 26 1985. The Secretary for SCT had announced on October 24 that national telephone links had been restored to seventy percent and that it was largely thanks to the Morelos A satellite (12). At the same time there was a bi-annual reunion of delegates from the communications schools of Mexico held in Culiacan. It was widely commented that telephone communication was greatly reduced and from the Provinces to Mexico City non-existant, so just what was meant by seventy percent restored was unclear.

CONCLUSION

To sum up, Mexico is buying a satellite system that will provide more channels than could be filled short term, in the best of (economic) times. The acquisition of a national satellite system should come as a result of a process of building an infrastructure founded in national manufacture and the thorough preparation of technicians, to service the system as well as 'support' professions that are able to use telecommunication systems. Mexico along with other developing nations has a history littered with examples of misapplied development project. During the Echeverría Regime, the state of Puebla outfitted several thousand classrooms with the most advanced audio-visual equipment, to be used as the cutting edge of educational improvement. Less than three years later the entire system was literally shelved. There was a drastic shortage of maitenance technicians, inadecuate training for the teaching staff who were to be the primary users. By the time the system had collapsed. The political and therefore financial attention had meandered, as it is wont, onto other equally pressing matters, leaving another project totally compromised (13).

The Morelos Satellite System is presenting an infinitely more costly and crucial spectre, a case of what one hopes is not deja-vu. Mexico has a big stake in a sophisticated telecommunications industry as a keystone for development. A country must offer a decentralized infrastructure complete with good communications in order to attract investment.

It would have been far better for Mexico to have developed its electronic communications infrastructure to the point where it could not proceed without its own satellite system. The sad fact is that Mexico has bought forty four channels when it is still only renting four. The expected boom to twenty channels in use by 1985 never occurred and as a result the MSS will be under utilized at best by anywhere from 40% to 80% troughout 70% of its lifetime.

This much has been apparent to most of the academic sector for the last few years. The question as to why the Government reacted to the notion of a Mexican Satellite System the way it did, is still very much open to speculation. Given the history, the most likely argument lies in the direction of a mixed economy in which the state functions as rector in the affairs of the nation; and as such it must, whether it is able to or not, take an active role in areas such as telecommunications. Televisa's interest is primarily television, but the Government cannot leave broadcast entirely in the hands of the private sector, for reasons established in the Political Constitution, thus serving as a balance for commercial, educational and cultural content, making it consistent with general broadcast policy. The reality however is that Televisa will no longer pay for the satellite, but the system's specifications have remained the same as those for direct broadcast; and the 44 earth stations later augmented to 95 are in the process of being concessioned off to Televisión de Provincia, S.A. de C.V. affilated by stock and management to Televisa (2). The Government has become a partner in Televisa's expansion, a fact which bodes well for Televisa, which after all, has acted in its own interest. But the role of the Government in a mixed economy model becomes somewhat blurred and almost rethorical.

Naturally, the decision to buy a national satellite system becomes popular when linked to notions of sovereignity and self-determination born of national maturity. But it 'coincidentally' came after the nationalization of the banking system, a populist move. Only time can tell if the Government is able to reaffirm its role as Rector of the State or allow the Private Sector certain prerogatives unforseen in the Political Constitution. Added to which the balance between rural and urban areas would be adversely affected, unless development policies are well thought out and implemented with care.

Thus the nexus at the moment will seem to be: can the Government continue its role of societal regulator? Will it allow itself to be privatized? And throughout all of this can it integrate the various sectors, in order to make optimum use of human and technological resources? Failure to do so will result in Mexico forever chasing technology, and search of The Techno-solution where a more holistic approach is necessary.

NOTES

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9) Excélsior. México, D.F. 14, March, 1985.
10) Excélsior. México, D.F. 23, March, 1985.
11) EL Heraldo. México, D.F. 28, November, 1985.
12) Channel 5 News. México, D.F. 25-26, October, 1985.
13) Interview with Professor Ignacio Márquez Rodiles. Research Officer. Universidad de las Américas. May, 1985.

EL SERVICIO MOVIL MARITIMO Y LOS PAISES EN DESARROLLO

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1. Resumen

El propósito de este trabajo es lograr un perfeccionamiento en las telecomunicaciones internacionales en el extremo estaciones costeras del servicio móvil marítimo ubicadas en países en desarrollo. Para tal fin, se sugiere elaborar un régimen de compensación de gastos por servicios radioeléctricos costeros recibidos y viabilizar un sistema de transferencia de fondos capaz de generar los recursos que autofinancien el crecimiento de la infraestructura actual del servicio, en dichos países.

2. ANTECEDENTES

El presente trabajo se complementa con el publicado en el Boletín de Telecomunicaciones de la UIT, Ginebra, Diciembre 1984 (Vol.51, pág. 650-654), y la finalidad total de los mismos satisface el espíritu de la Resolución Nº 316 de la Conferencia Administrativa Mundial de Radiocomunicaciones, Ginebra, 1979 "relativa a la cooperación técnica con los países en desarrollo en materia de telecomunicaciones marítimas", de la cual se desprende que en estos países pobres deben hacerse inversiones en las instalaciones y explotaciones de este tipo para que proporcionen adecuada seguridad a la marina mercante y a la flota pesquera y mejoren su rentabilidad; que es preciso incrementar la eficacia de los servicios en muchos países en desarrollo; y -pasando por la asistencia, colaboración y apoyo de proyectos- invita a buscar nuevas fuentes de financiación.

3. CARACTERISTICAS EXISTENTES

Las actividades en el extremo correspondiente a las estaciones costeras de las radiocomunicaciones bilaterales y de las ayudas radioeléctricas para la navegación marítima inherentes al servicio móvil marítimo, a la seguridad de la vida humana en el mar y a la protección del medio ambiente marino -preceptuadas por el Reglamento de Radiocomunicaciones y los convenios surgidos de las conferencias internacionales correspondientes-, corren principalmente a cargo de entes estatales. Consecuentemente estas actividades están mantenidas por los fondos públicos, o sea, sostenidas por cargas gubernativas aplicadas a las comunidades.

Las instalaciones de radio a bordo de los buques están en la práctica primordialmente al servicio de las comunicaciones propias de la empresa naviera, de la necesidad, ayuda y seguridad de sus barcos, sus contenidos, mantenimientos y derrotas. Secundariamente están empleadas para la correspondencia pública de los miembros de la tripulación y pasajeros. El tráfico comprende básicamente las comunicaciones radiotelegráficas y radiotelefónicas. El tráfico de correspondencia pública es tasado, el restante, no.

Por tráfico restante, debe entenderse las comunicaciones relacionadas con la seguridad de la navegación: señales de alarma y de socorro, llamada y tráfico de socorro por desastre o peligro inminente; señales y mensajes de urgencia por siniestros que entrañen un peligro para el buque; señales y mensajes de seguridad anunciando navíos en condiciones de avería, al garete, varados o escorados; avisos a los navegantes de rutina y de operaciones de apoyo y salvamento; advertencias en casos de tempestades, huracanes, ciclones y otros fenómenos peligrosos; informaciones meteorológicas generales y mensajes de pronósticos del tiempo; comunicaciones de excepción por emergencias; anuncios para evitar colisiones en el mar, en estrechos y en canales de acceso por existencia de riesgos para la navegación en general representados por hielos, derrelictos, y restos peligrosos de naufragios; escuchas en períodos de silencio; marcaciones radiogoniométricas; consultas y consejos médicos; necesidades para operaciones de recalada, practicaje y alije; datos de posición, fuerza de los vientos y estado del mar; alturas de aguas en puertos y ríos, horas previstas de llegada, entradas a puerto, etcétera. Asimismo, el desempeño de estaciones de radiofaros e instalaciones de ayudas electrónicas a la navegación.

Como se ve todo hace fundamentalmente al interés de la actividad de la empresa naviera; no de otros. Esto se evidencia aún más con el avance de la automatización de maquinarias, control y gobierno de los buques que se viene introduciendo en la industria constructora de navíos, lo que reducirá grandemente la dotación de personal tripulante para la navegación.

4. ASPECTOS ECONOMICOS

En la mayoría de los casos las estaciones costeras están instaladas y son sostenidas e implementadas por las administraciones a las cuales pertenecen. En los países pobres no existe una unidad orgánica dentro de las administraciones de telecomunicaciones que sea la obligada a responder por el examen económico o de rentabilidad a largo plazo de este servicio, lo que tal vez podría ayudar en algunos casos especiales a solventar gastos de explotación y mantenimiento. A veces la gestión de estas administraciones es insensible a las verdaderas necesidades de costos o a los incrementos de necesidades derivadas de la explotación del servicio. Es por eso que existen costeras sobrevivientes o de operación restringida. Se estima poco probable que dentro del orden establecido las costeras de los países pobres produzcan beneficios económicos.

En algunos de estos países, especialmente de superficie geográfica grande, se ha recurrido a excesivas instalaciones de estaciones costeras como procedimiento impulsivo para superar la incapacidad de la principal empresa de telecomunicaciones de proporcionar servicios internos adecuados que aseguren la cobertura completa de la nación. El aumento significativo de costeras en estos tipos de países acarrea, como consecuencia, substanciales perjuicios económicos, redundando en un empleo improductivo de los bienes y en última instancia, en costos técnicos, operativos y de organización altos para un servicio magro y de muy dudosa importancia en determinadas localizaciones. No se descarta que en muchos casos hayan sido las presiones de los intereses económicos en juego los que exigieron la implementación de costeras dentro del marco paupérrimo de determinado país. El disimulo filantrópico-social normalmente presentado para lograr movilizar u obtener los fondos necesarios es: la seguridad de la vida humana en el mar.

En la compra de instalaciones por parte de los países pobres se pueden lograr muchas veces resultados contrapuestos por recurrir a representantes o consultoras no conocedoras de las numerosas variantes y necesidades intrínsecas que tienen estos servicios, perdiéndose con la presencia de ellos la capacidad de mejorar la creatividad para superar las dificultades y necesidades auténticas y potenciales de cada estación costera; adicionando el agravante que muchas de estas intermediaciones trabajan a comisión de los abastecedores externos y a veces pueden estar ubicadas de tal forma que pesan invisiblemente sobre el poder público que tiene la llave de la decisión.

Es obvio reconocer que las implementaciones no deben estar a tono con pretenciones personales, sectoriales o particularistas, sino que tienen que estar determinadas por las necesidades y estrictas prioridades económicas, técnicas y sociales de cada nación. Hay casos en que la explotación deja mucho que desear debido a un esquema de remuneraciones bajas en el sector público como para conservar personal -que es especializado y debe tener conocimientos de idiomas apropiados- con la calidad y cantidad necesarias. No obstante según los casos, puede que quede personal, pero de baja idoneidad; lo que en definitiva no cambia el mal servicio y consecuentemente reporta aún más pérdidas por menos ingresos debido a la disminución del tráfico atendido. La carencia en la atención humana de las estaciones costeras es el fracaso del servicio que se pretende prestar.

En cuanto a la seguridad de la vida humana en el mar y la protección del medio ambiente marino, si se tiene en cuenta lo ya explicado en el trabajo anterior mencionado en el numeral 2, donde en lo que respecta al cubrimiento de los riesgos en la actividad naviera las empresas aseguradoras no exigen a las armadoras contar con costeras para cerrar verdaderamente el ciclo y cubrir realmente la seguridad tanto de vidas como de bienes; y, si se considera que los riesgos de perjuicio ecológico por contaminación de las aguas debido a vertimientos de hidrocarburos, a radiación nuclear y a substancias químicas de efectos tóxicos, se verán multiplicados en algunas zonas de los océanos Pacífico Sur, Indico y Atlántico Sur; se puede sostener con justa razón que la necesidad de perfeccionar la situación actual de las estaciones costeras de los países pobres pasa a ser una meta incontrovertible y de cierta perentoriedad.

De la unificación de los resultados de los estudios detallados en ese trabajo anterior, tomando como base la lista de los 31 países menos adelantados del mundo y la lista de los países de Latinoamérica y Antillas, se obtiene como conclusión que de un total de 70 Estados (que representan el 42 % del total de los países del mundo y sólo el 49 % de los países pobres), 48 de ellos (o sea 68 % de los 70) mantienen costeras de instalaciones y atención costosas. Esta conclusión plantea la siguiente incógnita: ¿Tienen estos países pobres empresas navieras con flotas mercantes tan importantes que su volumen y actividad justifique el gasto que acarrean sus estaciones costeras y el soporte de las estructuras que existe detrás de las mismas?

Doce de los 70 Estados estudiados pertenecen a la Cuenca Pacífico.

5. EJEMPLO DE COMPARACION

Para enfocar mejor estas ideas básicas y ver de quién es la necesidad real, se puede hacer una comparación con otro servicio de gran transporte. La más simple podría ser con las compañías de ferrocarriles ya que la explotación de su negocio requirió la construcción de los ramales de vías férreas, convoyes, estaciones terminales e intermedias, y las instalaciones de señalización y comunicación. Aunque los génesis históricos fueron distintos (pues a los puertos arribaban naves de cualquier dueño mientras que a las estaciones ferroviarias llegaban trenes de un mismo dueño) el principio básico para la finalidad de este trabajo no cambia y es el siguiente: si desaparecieran los trenes; estarían de más las estaciones, las vías férreas, los sistemas de señales y sus telégrafos. Análogamente, si desaparecieran los barcos, entonces los puertos, faros y estaciones costeras no tendrían razón de ser.

Siendo este razonamiento una verdad indiscutible, las estaciones costeras deberían ser instaladas y mantenidas por las empresas armadoras, que son en definitiva las que se lucran, y no por las administraciones de los países. Estas empresas deberían cubrir, como las cubrieron los ferrocarriles, todas las necesidades inherentes a la actividad naviera que realizan: unidades de transporte, mantenimiento, elementos de ayuda a la navegación, seguridad y comunicación. Las necesidades reales y directas son de las empresas; no de los países.

6. FINALIDAD DEL TRABAJO

Este trabajo pretende simplemente mostrar la relación causa-efecto y abrir el camino aportando algunos puntos de vista, describiendo un nuevo enfoque y sugiriendo acudir al razonamiento y a la labor colectiva. En el caso que nos ocupa, un nuevo enfoque más justo se lograría generando un acuerdo internacional sobre normas de interrelación para determinar y concretar reintegros económicos por servicios recibidos, o sea, elaborando un régimen de compensación de gastos por uso de costeras y conexos, y un sistema de transferencia proporcional de fondos. Unica manera de que los costos de explotación sean cubiertos por los que necesitan del servicio y usan verdaderamente su infraestructura.

En la medida que los países pobres sigan siendo más pobres, el problema de las radiocomunicaciones marítimas se complicará y redundará en directo perjuicio de las mismas empresas armadoras y compañías aseguradoras. Los estudios de especialistas del sistema bancario internacional demuestran que con mucha suerte interna y con muy buena ayuda externa un país pobre puede ponerse a la par de uno desarrollado promedio recién al cabo de unos 150 años. Aunque ese lapso disminuyera a la mitad debido a factores imponderables, por el lado de los países pobres la verdadera conclusión en este tema es que sólo se garantizan para las facilidades de radiocomunicaciones marítimas -principalmente en las vastedades del Pacífico Sur, Indico y Atlántico Sur- varios decenios futuros de comunicaciones regulares o malas; situación directamente en contraposición con los intereses de las grandes empresas armadoras, compañías aseguradoras, clubes aseguradores por daños y perjuicios debidos a la contaminación y con los de la tan mentada y blandida seguridad de la vida humana en el mar.

7. PROPOSICIONES

Todas estas opiniones, demostraciones y pronósticos no procuran revertir lo existente, sino perfeccionar lo existente. El problema planteado no es sencillo, algunas soluciones simplistas no estudiadas en profundidad serían verdaderos errores, por ejemplo:

a) Aumentar las tasas de la correspondencia pública.

-No representaría solución frente a la voluminosidad de comunicaciones no tasadas que en parte se detallaron en el numeral 3.

b) Tasar las comunicaciones para la seguridad de la navegación.

-No sería prudente porque, además de tener un caracter humanista, en muchos casos son de difusión masiva.

c) Resarcir igualitaria o diferenciadamente a las costeras con las cuales se comunica.

-No sería equitativo ni justo por:

1) Si es costera de país terminal de línea, tal vez comunicó poco y es en ese país donde se origina la riqueza en transporte que se comercializa.

2) Si es costera intermedia o de país en tránsito, tal vez se comunicó mucho pero ni siquiera se tocó las costas de ese país; o sea, no se movilizó riqueza de allí.

d) Resarcir a todas las administraciones que tienen salida al mar y costeras.

-No sería racional porque hay países sobre agua que son de simple tránsito, mientras que la riqueza transportada tal vez corresponde a países mediterráneos.

e) Resarcir a las administraciones en base a la cantidad y/o tonelaje de barcos matriculados en sus puertos.

-En algunos casos sería irrisorio. (Se reserva la explicación escrita al respecto para no entrar en asuntos de engorroso tratamiento).

Lo conveniente quizás sería efectuar una clasificación o categorización a nivel mundial tanto de las empresas navieras como de las estaciones costeras, determinando las magnitudes de las mismas; para las primeras, en base al tonelaje de arqueo bruto afectado a la transportación internacional o a la cantidad y tipo de productos de las cargas transportadas. Para las segundas, en base a la cantidad de tráfico, tasado o no, que cursan; servicios que prestan justificados por la densidad de tránsito marítimo o, importancia de las mismas respecto a las rutas marítimas.

Sería una obligación para los hombres de las administraciones de telecomunicaciones tratar de colaborar y aportar con rapidez en este asunto, no pretendiendo ventajas a corto plazo para sus administraciones propias. Sus responsabilidades como expertos, conocedores del servicio y sus reales alcances, les permitirían emplear sus experiencias para obtener un verdadero interfuncionamiento internacional de resarcimiento por gastos y mantenimientos, posible, seguro y desburocratizado; determinando la ecuación técnico-económica que permita que los factores tengan una relación directamente proporcional con su mayor o menor lucratividad, volumen o intervención, proponiendo que las contribuciones anuales se aporten a un centro internacional apropiado o "fondo repartidor", rector e imparcial, con un mecanismo que permita, de la forma más económica posible, asignar y transferir eficientemente los reintegros correspondientes. Todo dentro de un marco normativo intergubernamental regido por medidas adecuadas que incidan a un compromiso duradero, en el cual se podrían introducir innovaciones y se podría seguir avanzando con confianza entre las administraciones.

Si debido a la presión de los escépticos y de los que irreflexivamente creen ver tocados sus intereses se titubeara en encarar este perfeccionamiento en forma integral desde un principio, se podría elaborar un programa o proyecto piloto a aplicar en alguna o algunas subregiones con una duración de unos cinco años; haciendo en el interín un seguimiento con información actualizada sobre el avance y desarrollo del programa. Los resultados conseguidos al finalizar dicho programa respecto a reintegros anuales por gastos, implementaciones de equipos y de personal competente técnica y operativamente, y ejecución y cubrimiento de los servicios, permitirían una evaluación más realista capaz de introducir factores de corrección en cualquiera de los parámetros involucrados, y así llegar con mayor seguridad y confianza al perfeccionamiento completo dentro de un segundo programa.

Se considera que es imperioso que los especialistas imbuídos de toda esta problemática analicen lo aquí planteado en todos sus aspectos e implicancias, adicionen factores y elementos de juicio en pro y en contra no tenidos en cuenta en este trabajo por demás limitado, intercambien opiniones con expertos de disciplinas relacionadas y se vayan perfeccionando y ampliando las ideas básicas aquí esbozadas, haciendo un estudio en profundidad, no sólo contemplando el aspecto actual, sino la necesaria y real proyección futura.

8. CONCLUSION

La concreción de lo aquí sugerido producirá un beneficio. El beneficio para los países desarrollados no provendrá del suministro de una buena cantidad de equipos a los "pobres". El beneficio real del crecimiento del servicio será haber logrado -sin afectar las economías de los países en desarrollo- un sistema mundial de estaciones costeras más completo, mucho más eficiente y, por ende, mucho más fiable, con una utilización y aprovechamiento pleno de la infraestructura existente, sustentada por bases técnicas y operacionales, así como por mecanismos de compensación y mejoras de organización capaces de proporcionar la cobertura, la calidad y la eficacia que un servicio de este tipo requiere.

Todo ello redundará en beneficio directo de las grandes empresas navieras y aseguradoras, siendo las primeras las que necesitan de esa infraestructura y las que verdaderamente usufructúan este servicio. Esta utilidad significará un verdadero retorno donde se recobrarán seguramente varias veces los fondos invertidos y se contribuirá a evitar perjuicios ecológicos en las aguas del mar. Además, recién a partir de allí, la comunidad marítima navegante podrá ver cristalizados los esfuerzos que se vienen impulsando detrás de los objetivos del Convenio para la Seguridad de la Vida Humana en el Mar, en mucho mayor grado que hasta ahora; todo lo cual representará un verdadero beneficio en términos de rendimiento social.

AUSSAT - A NEW ERA FOR PACIFIC TELECOMMUNICATIONS

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The launch in mid-1986 of the third AUSSAT satellite will provide an unprecedented opportunity for the establishment of Ku-Band satellite communications services to the South Pacific. The satellite payload modifications to permit this service opportunity will be described along with an outline of the scope of the potential applications which range from telephony to broadcasting.

INTRODUCTION

It has long been recognised that satellite technology offers an ideal solution to the problems of providing high quality telecommunications services to widely distributed populations. Indeed the prime motivation for the establishment of the AUSSAT system was the desire to reach the remote and sparsely populated regions of inland Australia with telephony, television and radio services comparable in quality to those enjoyed by the city dwellers. Nowhere else is the problem so clearly stated as in the South Pacific with its far flung pattern of islands, some with very small populations, being practically and economically impossible to interconnect with telecommunications and broadcasting services using terrestrial technologies.

Many writers have highlighted the need for the immediate provision of a dedicated satellite coverage of the South Pacific to offer the much needed communications services. Now, the opportunity is close to reality with the launch in the middle of this year of the third AUSSAT satellite which will carry on board a dedicated antenna system to provide coverage of the South Pacific. For the first time a wide range of flexible cost-effective services can be implemented ranging from television distribution to thin route telephony to point-to-multipoint services. All these services can be made available to any location within the coverage area.

HISTORY

The design for the first AUSSAT system derives from the work of the Australian Government's National Satellite Task Force in the late 1970s. In accordance with its Terms of Reference that inquiry limited its considerations to satellite services for Australia, New Zealand and Papua New Guinea (PNG). In the event PNG identified an intent to use the satellite whereas New Zealand declined. In 1980 with the system design completed and the Request for Tenders about to be released the possibility of coverage for the South West Pacific was raised.

At that time, in the absence of any detailed definition of requirements and given the limited knowledge then available of the impact which the inclusion of a South West Pacific service would have on both the satellite design and the overall program schedule, it was concluded that the prospective needs of the South West Pacific could not be satisfied by the first generation AUSSAT system without substantial additional costs and delays. However, the decision was made to include the consideration of the telecommunications needs of the South West Pacific countries in the planning of the second generation AUSSAT system and that Australia would support the region during the intervening period in assessing its needs and advising on the various alternatives available.

Following a meeting of the South Pacific Forum in April 1983 at which Australia reaffirmed its intentions to consider the region's needs in planning the second generation AUSSAT system, the South Pacific Telecommunications Development Program (SPTDP) was established to be responsible for co-ordinating the development of telecommunications within the twelve member nations of SPEC, the South Pacific Bureau for Economic Co-operation. Prior to the setting up of the SPTDP no equivalent organisation existed with whom meaningful and coordinated discussions could take place on the potential communications needs of the South Pacific region.

At the SPTDP's request, a meeting with AUSSAT was convened in December 1984 as a means of initiating the exchange of information required in planning for a South Pacific service on the second generation AUSSAT system. Given that AUSSAT then had a very detailed knowledge of the current spacecraft design and mechanical layout, the possibility emerged of adding a capability on the third satellite to provide service for the South West Pacific. This was not possible on the first and second spacecraft due to their advanced stage of construction. Following the detailed assessment of the proposed modifications to the third satellite a decision to proceed was taken in early 1985.

AUSSAT SYSTEM OVERVIEW

The AUSSAT system [1] will comprise three identical satellites in geostationary orbit at 156, 160 and 164 degrees East. Of these the first two have been successfully launched by the Space Shuttle and occupy the 160 and 156 degrees East locations. The third satellite which will carry the South West Pacific capability, will be launched in mid-1986 by the Ariane launcher and will orbit at 164 degrees East.

The Ku-Band has been chosen for the AUSSAT system with uplinks in the band 14.0 to 14.5 GHz and downlinks at 12.25 to 12.75 GHz. In the ITU Region 3, which includes Australia and the South Pacific, the downlink band 12.25 - 12.5 GHz is available only for Fixed Satellite Service (FSS) applications. The upper portion 12.5 - 12.75 GHz is a shared-usage band and is available for both FSS and Broadcasting Satellite Service (BSS). This flexibility, ie. the interchangeable use of frequencies above 12.5 GHz, and the ability to locate earth stations at or close to customer premises without the need for coordination with terrestrial systems were important factors leading to the selection of these frequencies for the AUSSAT system.

The coverage patterns for the spacecraft antennas have been tailored to closely match the intended service requirements, with careful consideration of population distribution and user's needs, both regionally and nationally. Each satellite has provision for two national receive and transmit beams, and four downlink spot beams covering Western Australia (WA), Central Australia (CA) (Northern Territory and South Australia), North East Australia (NE) (Queensland) and South East Australia (SE) (New South Wales, Victoria and Tasmania) respectively. Dedicated downlink and uplink spot beams are also provided to cover Papua New Guinea. The transmit spot beam coverages are shown in Figure 1.

The communications payload (Figure 2) onboard each spacecraft has 15 active communications channels, each having a minimum bandwidth of 45 MHz with a channel spacing of 64 MHz. Channels 1 to 8 constitute Repeater A and Channels 9 to 15 constitute Repeater B. The repeaters are arranged in a frequency reuse scheme employing orthogonal linear polarizations that are oriented so that nominal horizontal and vertical polarizations are received over Australia. The channel centre frequencies and the polarization plan are summarized in Table 1. Each channel has ground commandable attentuation to select one of three gain states for saturation flux density (SFD) control.

There are eleven active standard power amplifiers (nominally 12 Watts) being channels 1 to 6 in

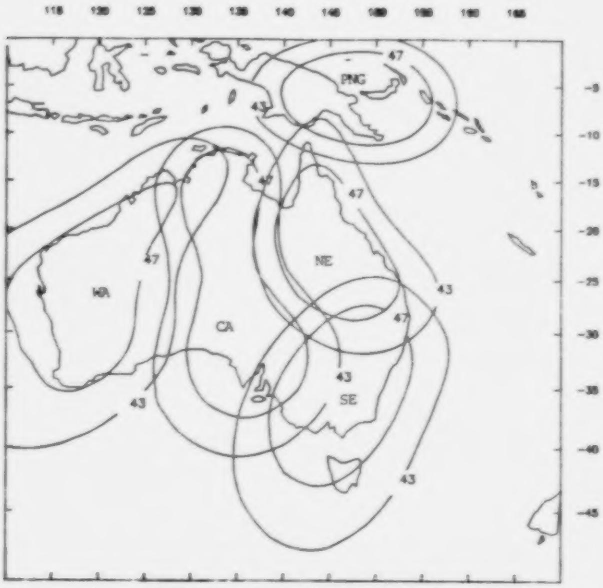

Figure 1. AUSSAT Transmit Spot Beam EIRPs for High Power Transponder Connections

Channel Number		Centre Frequency (GHz)			
		Uplink Polarization		Downlink Polarization	
Repeater A	Repeater B	H	V	H	V
1		14.025			12.227
	9		14.057	12.309	
2		14.089			12.341
	10		14.121	12.373	
3		14.153			12.405
	11		14.185	12.437	
4		14.217			12.469
	12		14.249	12.501	
5		14.281			12.533
	13		14.313	12.565	
6		14.345			12.597
	14		14.377	12.629	
7		14.409			12.661
	15		14.441	12.693	
8		14.473			12.725

Table 1. Frequency and Polarization Plan

	Repeater A								Repeater B						
Beams	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
National (A)	S		S	S		S	H								
National (B)									S	S		S	S	H	H
PNG				S		S		H							
NE									S		S			H	H
SE	S		S		S		H	H							
CA										S		S		H	H
WA		S		S			H	H							

S - 12 W transponder
H - 30 W transponder

Table 2. Transmit Connectivity Matrix

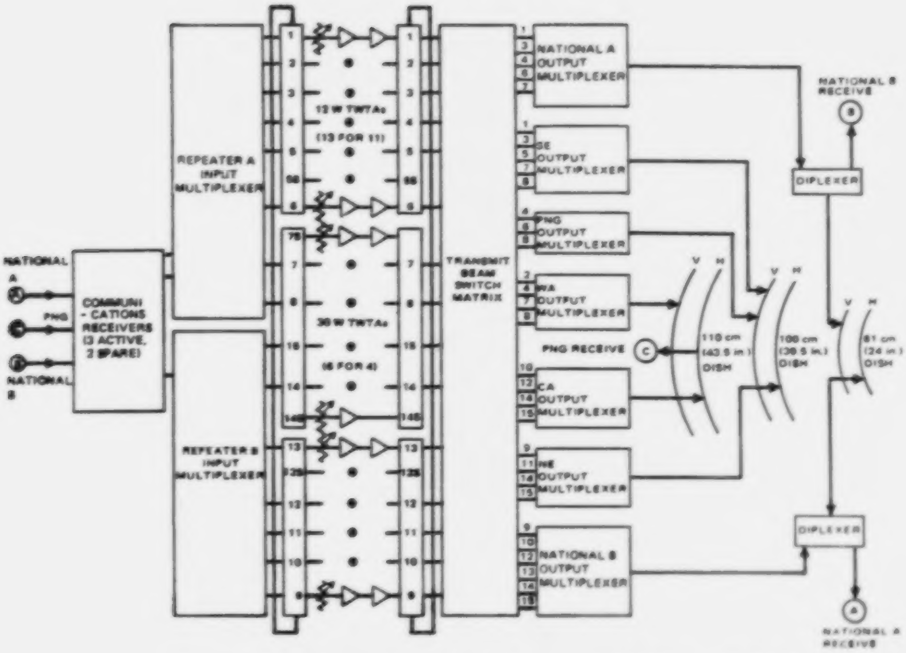
NATIONAL A
PNG
NATIONAL B
COMMUNI-CATIONS RECEIVERS (3 ACTIVE, 2 SPARE)
REPEATER A INPUT MULTIPLEXER
REPEATER B INPUT MULTIPLEXER
12 W TWTAs (13 FOR 11)
30 W TWTAs (6 FOR 4)
TRANSMIT BEAM SWITCH MATRIX
NATIONAL A OUTPUT MULTIPLEXER
SE OUTPUT MULTIPLEXER
PNG OUTPUT MULTIPLEXER
WA OUTPUT MULTIPLEXER
CA OUTPUT MULTIPLEXER
NE OUTPUT MULTIPLEXER
NATIONAL B OUTPUT MULTIPLEXER
PNG RECEIVE
110 cm (43.5 in.) DISH
100 cm (39.5 in.) DISH
61 cm (24 in.) DISH
V
H
DIPLEXER
NATIONAL B RECEIVE
NATIONAL A RECEIVE

Figure 2. The AUSSAT Spacecraft Communications Payload

Repeater A and 9 to 13 in Repeater B, and four active high power amplifiers (nominally 30 Watts) being channels 7 and 8 in Repeater A and 14 and 15 in Repeater B. To ensure that the high payload reliability targets are met two spare amplifiers of each type are carried in a redundancy configuration that will permit any two amplifiers of a particular type to fail without loss of service.

A key feature of the AUSSAT payload is the substantial transponder/beam connectivity provided with 31 transponder/beam combinations being available to ensure adequate flexibility to meet changing market demands. The transmit connectivity matrix is shown in Table 2.

PAYLOAD MODIFICATION

The modification to the payload of the third satellite to permit the provision of the South West Pacific service consists of

- Two additional antennas (rectangular horns) to provide transmit and receive coverage of the South Pacific region including New Zealand
- Waveguide switches to select by ground command either South Pacific or PNG coverage.

Even with the South Pacific modifications the original switching capability on the spacecraft has been maintained. Additionally however, it is now possible to independently switch by ground command up to one 30 Watt transponder (number 8) and two 12 Watt transponders (numbers 4 and 6) to provide South Pacific coverage. The only operational constraint on the switching is that a PNG beam service and a South Pacific beam service are not possible from the third spacecraft at the same time. Therefore, should both the South Pacific and PNG require capacity the PNG requirements could be provided by a transponder on one of the first two satellites, subject to availability, or by a South Pacific transponder on the third satellite given that PNG is within the coverage area of the South Pacific beam. Figure 3 shows the payload block diagram for Repeater A only on the third satellite to indicate the configuration of the South Pacific antennas and the beam switching constraints.

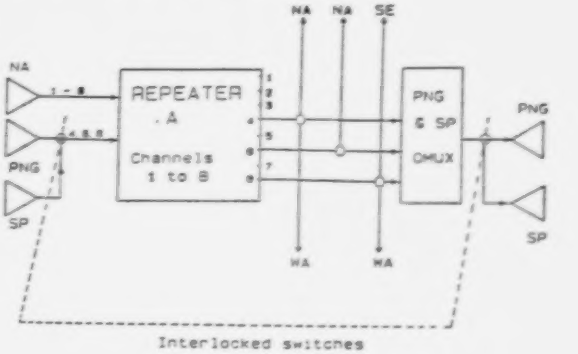
NA
NA
SE
NA
PNG
SP
1 - 8
4,6,8
REPEATER A
Channels 1 to 8
PNG & SP OMUX
PNG
SP
WA
WA
Interlocked switches

Figure 3. South Pacific Modification to Repeater A on the Third AUSSAT Satellite

SOUTH WEST PACIFIC BEAM PERFORMANCE

The decision to modify the third satellite was made very late in the spacecraft construction phase and so the resulting performance is substantially less than could have been achieved with a defined service base and a design adopted from the outset to meet that service objective. However, adequate coverage has been provided over the region with approximately circular uplink and downlink beams. Figure 4 shows the predicted EIRP performance for the 30 W and 12 W transponders and Figure 5 shows the G/T and saturation flux density (SFD) predicted for the South Pacific beam.

To control interference between the South Pacific beam and services to the east coast of Australia the polarization orientation of the South Pacific horns is identical to that of the other Repeater A antennas. A consequence of this is that the nominally horizontal receive beam is in fact closer to vertical over the South Pacific and conversely for the transmit beam. Figure 6 shows the variation of the polarization angle over the region.

KU-BAND PROPAGATION

The relative merits of Ku-Band and C-Band services for the South Pacific have been widely debated in the past. It is well known that transmissions in the Ku-Band are subject to attenuation and depolarization effects in heavy rain. However, these phenomena are amenable to statistical analysis and theoretical modelling to permit the system designer to adequately compensate for them. AUSSAT has expended considerable effort in developing expertise in this area ever since the decision was made to utilize the Ku-Band for Australia. Theoretical models linking rain attenuation tc rain rate have been developed based on CCIR models and have been shown to be somewhat conservative when compared with experimental data.

There are a number of alternative approaches to dealing with rain attenuation phenomena in the design of satellite communications systems. The most direct way is to design the link with sufficient margin to deal with the predicted signal attenuation corresponding to the maximum rain rate experienced for the target availability. It should be noted that in a telephony service if the link margin has degraded to zero the voice channel quality is then equal to the desired level and the system will continue to work, albeit with higher noise levels, if the carrier-to-noise ratio drops below the target value.

Another approach, and one that will be employed in Australia by a number of AUSSAT users, is to implement a system of uplink power control. Here the signal strength arriving at the satellite is kept within predetermined limits by either a step variation or continuous variation in the earth station EIRP. A radiometer can be used to measure the sky noise temperature to provide a measure of the uplink attenuation.

Yet another approach to compensation for rain attenuation is to choose digital modulation techniques that employ robust coding methods and that can withstand degradation in the bit error rate of the link. Advanced error correcting codes and variable bit rates can be implemented to ensure adequate resilience against rain fades whilst still maintaining an operable communications link within the availability target for the service.

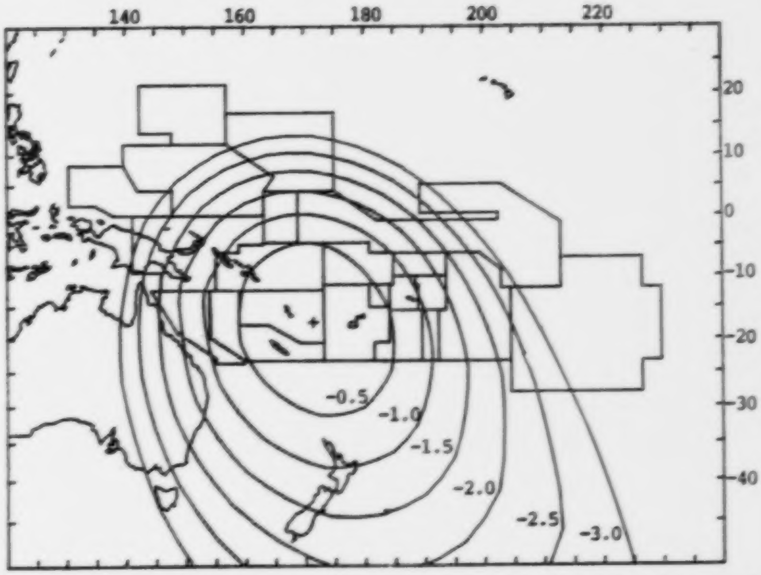

Figure 4. South Pacific Predicted EIRP Coverage Contours in dB. Peak for a high power transponder connection is 36 dBW and for a standard power connection is 31.5 dBW

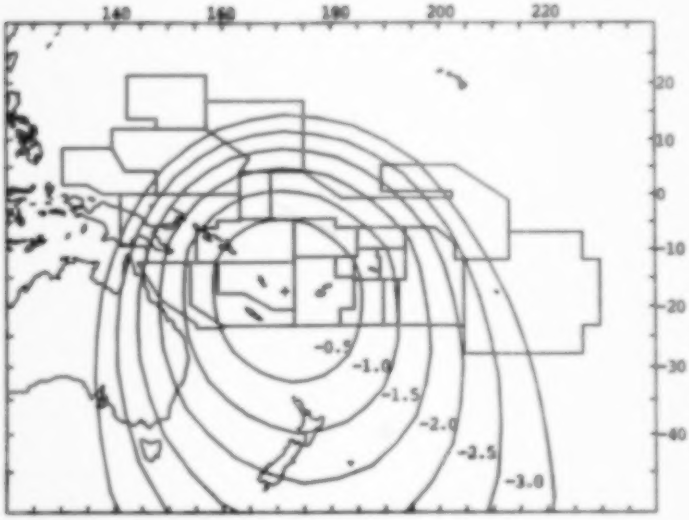

Figure 5. South Pacific predicted G/T contours in dB. Peak G/T = -6.5 dB/K. For SPD the centre corresponds to a minimum SPD of -76.5 dBW/m^2 and the contours show increasing SPD

AUSSAT in conjunction with the South Pacific Telecommunications Development Program (SPTDP) is mounting an experiment in Suva using a dual frequency radiometer to gather first-hand C-Band and Ku-Band rain attenuation data in the South Pacific. The apparatus consists of a 1.2m radiometer at Ku-Band and a 2.4m radiometer at C-Band. The antennas will be pointed to the geostationary arc and the sky noise temperature readings automatically recorded for subsequent analysis and correlation with the readings from an associated tipping-bucket rain gauge. The radiometers will be installed in the first quarter of 1986 in Suva with the cooperation of the SPTDP.

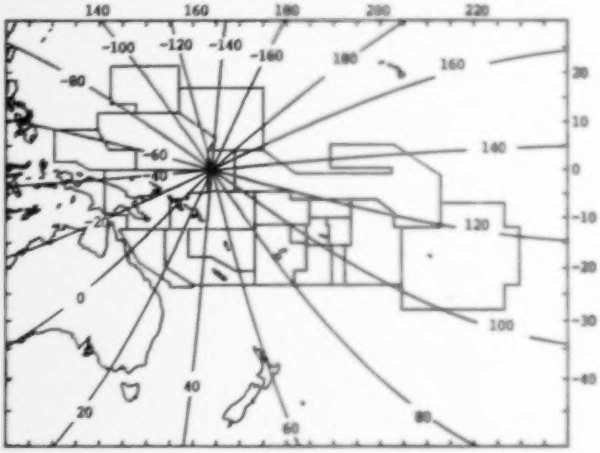

Figure 6. The variation of the polarization angle over the South Pacific. The plots show the angle between the local horizontal and the nominally horizontal electric field, measured in the plane normal to the line between the earth station and the satellite in a positive clockwise sense looking towards the satellite.

The use of the Ku-Band offers a number of distinct advantages to users in the South Pacific including the opportunity for higher satellite EIRP performance, the use of much smaller and cheaper earth stations which are more environmentally robust, the potential for enhanced flexibility in the system design, and greater scope for service applications.

Satellite antennas are generally constrained in size by the launch vehicle envelope and mass considerations so that a Ku-Band satellite antenna would offer substantially higher gain than a C-Band antenna of the same diameter. Higher antenna gain leads directly to higher EIRP and G/T performance in orbit. For a regional beam the antenna gain may be determined primarily by the size of the desired coverage area but at Ku-Band the opportunity exists for spot beams of substantially higher gain covering individual nations or groups of nations with the prospect of enhanced system flexibility by utilizing both spot uplinks and downlinks.

A similar benefit is available to the earth station antenna except that the advantage is that for a given EIRP or G/T target the dish diameter will be reduced compared to the equivalent requirement at C-Band. A smaller earth station will offer lower wind resistance and the potential to be made substantially more robust in cyclone conditions. Furthermore, a smaller antenna will be cheaper to purchase, transport and install.

Although Ku-Band transmissions are more susceptible than C-Band to propagation phenomena the advantages in terms of higher satellite performance, greater system flexibility, smaller earth stations, and more environmentally robust installations make the balance less obvious than is often assumed. Indeed, a vital aspect of the

South Pacific service offered on the first generation AUSSAT system is the opportunity to establish services in the region to provide valuable practical insight into the performance of the Ku-Band in the South Pacific.

SERVICE APPLICATIONS

Although the South West Pacific beam covers a large area the performance level is nevertheless adequate to support a wide range of potential applications including telephony, television, point to multi-point services, electronic mail, cyclone warning facilities and so on. By way of example a brief description of a possible thin route telephony application and television distribution service via the AUSSAT system is provided.

Telephony

Assuming a 12 Watt transponder for telephony services and 4.5m earth stations in the network the transponder capacity is around 300 channels using voice activation techniques. A precise definition of the system capacity depends of course upon the details of the specific applications but this figure is representative and assumes an 8 dB link margin for rain attenuation to provide an availability in excess of 99.7% of the worst month based on the rainfall statistics of Innisfail in Queensland, Australia which has rain rates similar to those of the Solomon Islands. The telephony applications could range from star network thin route trunking systems with larger hub stations for improved capacity to mesh networks of earth stations for flexible services to small communities. Telephony services could be provided anywhere within the coverage area.

Television

With a saturated 30 W transponder a television service could be received throughout the coverage area with 4.5m antennas for individual or small community reception. For a particular location the service availability would depend upon the local rainfall statistics and the link margins which in turn depend upon the satellite EIRP at the location in question. The absence of detailed rainfall data makes accurate availability calculations difficult but, by once again using the rainfall statistics of Innisfail, the service availabilities will exceed 99.3% in the worst month throughout the coverage area.

The uplink facility would require an 8m earth station which could similarly be situated anywhere within the coverage area. For high availability studio quality program distribution to terrestrial retransmission sites earth stations of up to 8m diameter would be required, with the actual size dependent on location within the coverage area.

FUTURE PROSPECTS

The first generation AUSSAT South Pacific service represents the first tangible opportunity to develop the potential for cost-effective satellite communications in the Pacific. The modifications to the third AUSSAT satellite will permit the immediate development of domestic systems which can demonstrate the wide range of communications services available throughout the region including the economical distribution of television.

With the first generation system now operational and carrying commercial traffic AUSSAT is in the process of planning the second generation system with a view to placing contracts for the next series of spacecraft by early 1989. The planning phase will need to be essentially completed within the next two years in order to meet the second generation commissioning target of 1991-92. An important ingredient in the planning process is the consideration of the requirements for services to the South West Pacific and New Zealand and the existence of first generation systems in the region will be a valuable catalyst for the optimum design of South Pacific services on the next generation. One can reasonably expect that substantial improvement in satellite performance could be provided through the use of high gain spot beams covering individual countries or groups of countries leading to greater system capacity for the same earth stations installed for the first generation coverage.

The scope for future growth and development of satellite systems in the Pacific is almost limitless culminating in what could be called an ultimate solution for the Pacific - a dedicated South West Pacific regional network designed to provide to all island nations the types and qualities of service that truly reflect the region's needs. The experience that AUSSAT will have gained through working closely with our Pacific neighbours in this and subsequent generations will position us well for providing valuable assistance in the planning and development of such a South Pacific regional satellite system.

Irrespective of whether or not such a dream becomes a reality the economic and social development that will flow to the Pacific island nations through the cost-effective delivery of satellite communications services will enrich the island way of life and strengthen national and international bonds within the South Pacific region.

REFERENCE

[1] W.L. Nowland and M.J. Houterman, "AUSSAT - Australia's Communications Satellite System", AIAA 10th Communication Satellite Systems Conference, March 1984, 283 - 298

APPLICATIONS OF SATELLITE MOBILE EARTH STATIONS - THE CANADIAN EXPERIENCE

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Summary

Over the past ten years, Telesat Canada has developed, built, and operated mobile earth stations for use with its ANIK satellites. A synopsis of applications is given, together with required features of a mobile earth station.

Introduction

Telesat Canada bears the distinction of being the owner and operator of the world's first domestic satellite telecommunications system. Since 1972, when its first ANIK satellite was launched, Telesat has been at the forefront of applied technology in both the C- and Ku-bands.

To efficiently deliver signals over the large expanse of Canada, a network of fixed earth stations was built. Telesat found that with the higher power available from its second-generation satellites, low power uplinks could be used. Small, easily-moveable earth stations were introduced for temporary use in locations where permanent facilities were not possible or where terrestrial lines were not available. A further development placed the small earth station on a trailer which could be towed by a truck.

From this starting point, Telesat continued development of transportable earth stations.

Upon the launch in 1978 of the hybrid (C- and Ku-bands) Anik B satellite, additional advantages in the way of reduced antenna size were possible. A prototype mobile earth station for use at 14/12 GHz (Ku-band) was designed and built by Telesat Canada in 1979. Intended as a "Satellite News Gathering" unit, this was indeed the world's first so-called SNG mobile.

In the space of five years, the use of a transportable requiring five days to erect a 10 metre antenna and provide service was superseded by a mobile using a 2.2 metre antenna requiring only 20 minutes from arrival to service provision.

Applications

Telesat Canada operates a fleet of Mobile Earth Stations and has built mobiles specifically designed for customers' requirements.

From base stations across Canada, both C- and Ku-band mobile earth stations are deployed to cover events in both the broadcast and data sectors.

By far, most of the requirements for the mobiles are for broadcasting use, and particularly for television.

Extensive use is made of the units for sports broadcasting where the point-to-multipoint nature of distribution lends itself well to satellite usage.

Reliability of communications equipment is critical. Having deployed a mobile earth station, one must be confident of success in signal delivery. The stress on the electronic equipment when in transit is considerable, as the equipment cannot be separately stored in packing cases and be re-integrated when required. By special design and layout, and attention to such aspects as shock-absorption, heating, ventilation, and air-conditioning, the reliability of these units has been maximized. To date, Telesat Canada enjoys an availability of 100% from its mobile earth stations.

Always aware of the visibility of their station in a community, broadcasters use the vehicles to relay fast-breaking news items live from the scene. Here, particularly, the use of mobile earth stations is important. Unlike sports venues where schedules are known weeks or months in advance, news gives no advance notice. Fast set-up time is important - the news does not wait until the broadcaster has arrived and is ready. Quick on-the-road-again time is important too. For these reasons, Telesat Canada's mobiles are designed to minimize the time taken to prepare the vehicle for satellite transmission. Typically, the technician/operator can have the unit ready to transmit in fifteen minutes after arrival on-site.

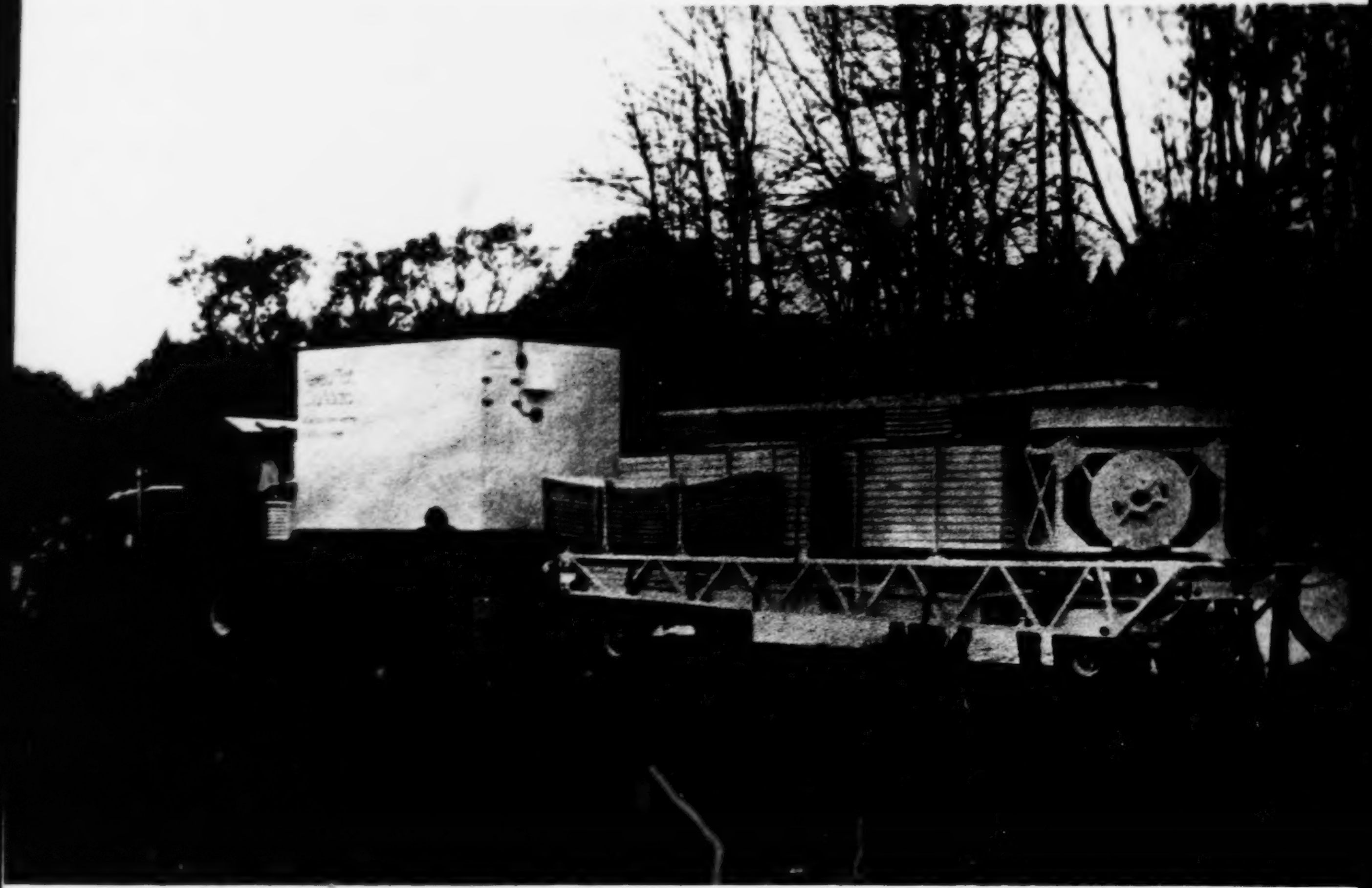

Figure 1 - Telesat 10 metre Transportable Earth Station
Photo November 1974

Videoconferencing is one of the uses to which the mobiles have been put, but videoconferencing with a difference. Mobiles are used for cattle auctions and in one trial case, by the Supreme Court to gather submissions from lawyers across the country on a topic of urgent and pressing necessity. The visits by dignitaries such as Pope John Paul II and Queen Elizabeth have recently been covered.

In some cases, one vehicle is tasked with an extensive tour. In the summer of 1984, a newly-built unit left Ottawa for a tour of duty. It travelled to San Francisco to cover the U.S. Democratic Party Convention there, then was immediately sent to Los Angeles for the Summer Olympic Games. Its next stop was Dallas for the Republican Party Convention, then New Orleans for demonstrations. The vehicle then had to go to Baie Comeau Quebec to be part of the Canadian election night coverage and on the way back to Ottawa it did a sports feed of the Grand Prix auto race in Montreal. The total trip was 12,000 km, the trip duration was two and one-half months, and the reliability was 100%.

During this assignment, outside temperatures sometimes reached +40°C. Operation of the mobile earth stations in winter when temperatures reach -40°C is not without precedence. The need for equipment environmental control can be seen, but the need also for the operator's comfort must not be overlooked. When repairs need to be done, or when manning the unit, adequate space must be provided. Telesat Canada has designed its mobile earth stations such that all electronic equipment, except for the low-noise amplifiers, can be accessed from within the equipment enclosure.

Typifying the use in the area of data distribution, are mobile earth stations used by the military. No more exacting customer can be found, than in the area of defense. All aspects of a mobile earth station become critical and at once demonstrate the versatility and reliability of the units.

Conclusion

Mobile earth stations are in extensive use in Canada for a variety of applications permitting the economical and innovative use of satellites to complement existing transmission systems.

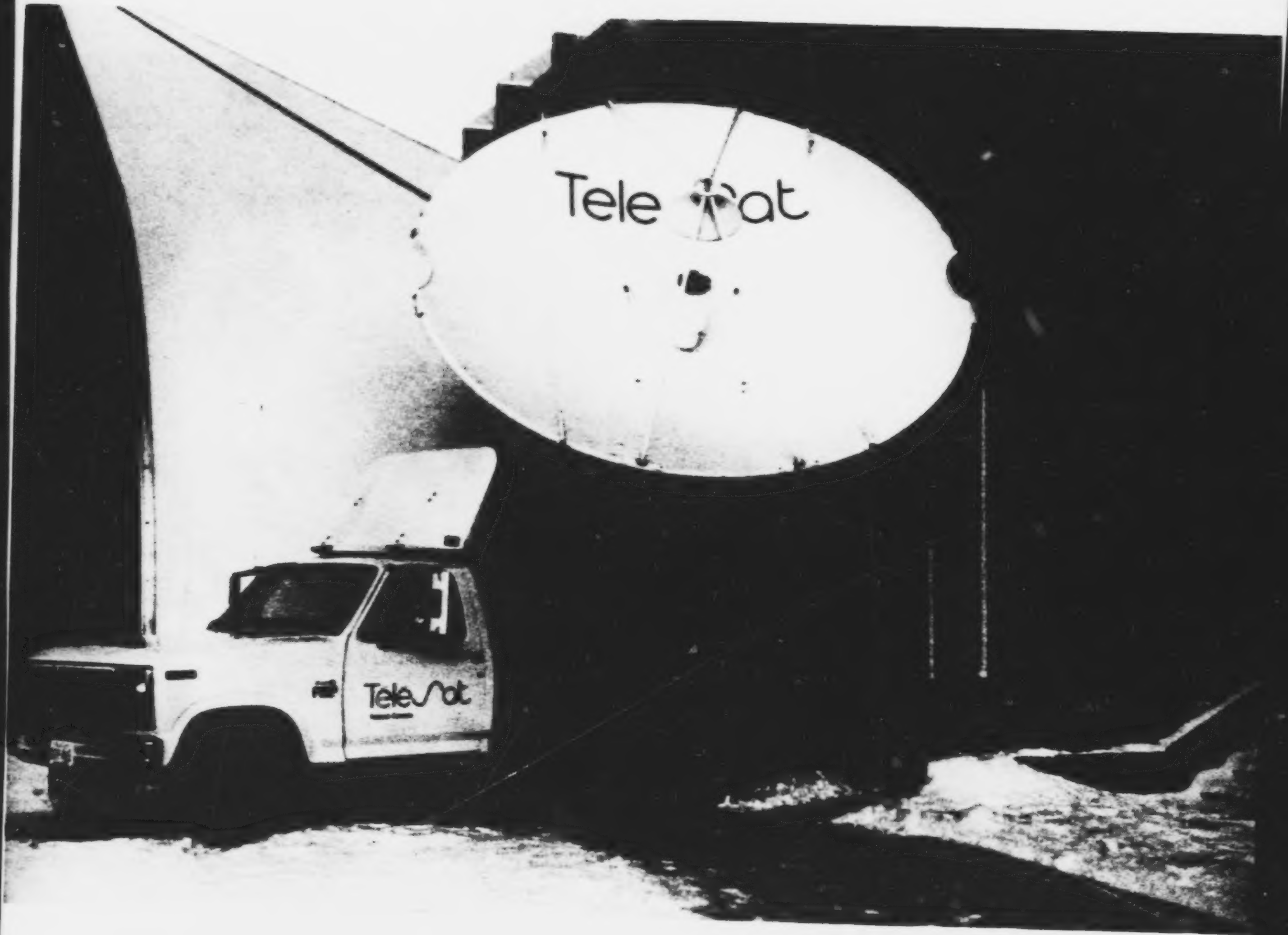
Telesat
Telesat

Figure 2 - Telesat 4.5 metre C-Band Mobile Earth Station
Photo May 1985

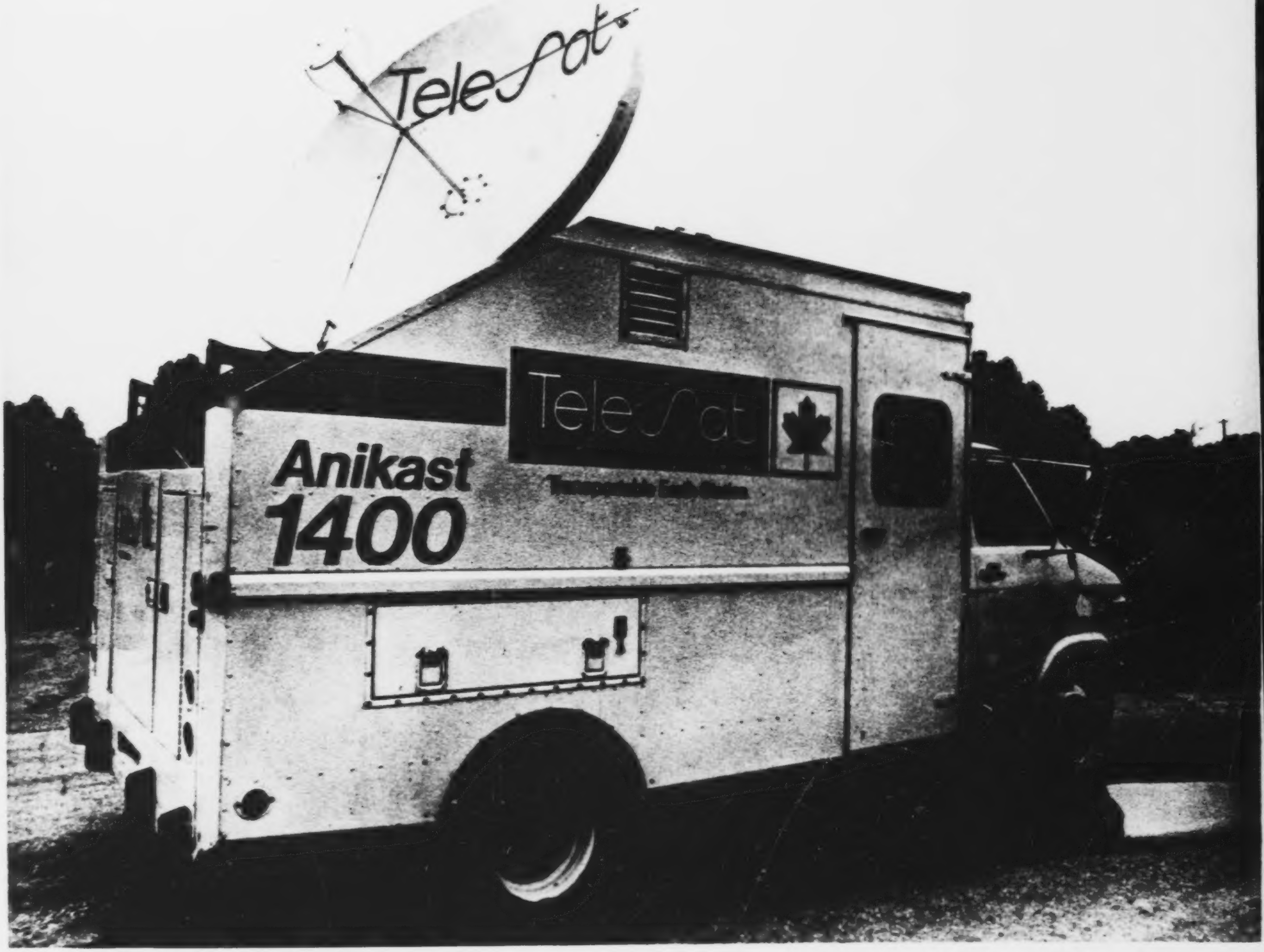
TeleSat
TeleSat
Anikast
1400

Figure 3 - Telesat 2.2 metre Ku-Band Mobile Earth Station
Photo May 1985

SERVICES, THEIR REGULATORY AND POLICY FRAMEWORK IN THE LIGHT OF THE EMERGING "INTEGRATED SERVICES DIGITAL NETWORKS"

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A policy framework on telematics (the combined use of telecommunications and informatics/computer services) should endeavour to minimize the risk of restrictive trends in telematics as well as to reduce the uncertainty faced by the trading circles, while not forcing governments to commit themselves in great detail on uncertain policy issues regarding the nature of innovation and technological changes in telematics.

The trade, business, travel and cultural exchanges among the 33 Pacific nations are now bigger than among the Atlantic countries. In 1984, for the first time, the value of trans-Pacific trade exceeded that of trans-Atlantic trade. In particular, North American (United States and Canada) exports to the Pacific area reached the same size as exports to Western Europe. Between 1973 and 1984, six new names appeared on the list of the top 20 exporting countries and, among these six, five are Pacific nations: South Korea, China, Hong Kong, Taiwan and Singapore. All five countries moved into the top 20 importers which underlines the lesson that dynamic suppliers are also dynamic customers. The fact that they achieved the highest average increases in gross domestic production during the decade testifies to the positive relationship between export growth and economic growth.

The momentum is building across an ocean some 65 per cent bigger than the Atlantic and covering an area twice as vast as Asia and America put together. Mutual consciousness grows between the 33 littoral states which the Pacific ocean is slowly drawing together. Today, 60 per cent of the world's GNP originates on those shores and, since 1985, more aeroplanes cross the Pacific every day than cross the Atlantic.

Because telecommunications and informatics constitute not only a separate service sector in its own right, but also is a driving force behind world competition in many other service sectors like banking, professional and business services, insurance, construction, issues crucial to the smooth functioning of information flows should be accorded special attention.

In fact, a liberal attitude toward world-traded services is even more important than one towards goods because world-traded services play the strategic role of informing and directing the rest of the economy.

Motivations behind government intervention for restricting the flow of telecommunications, data processing and information services are those commonly presented in the case of goods trade (for example, balance-of-payments control, protection of domestic consumers from risk, infant-industry and employment arguments), except the motivations of protection of data or the access to data, the privacy of individuals, the security of information and the cultural and social sensitivities.

In addition, for as much as a hundred years, telecommunications throughout the world have been the domain of government-regulated monopolies. In the United States, privately owned AT & T was regulated by the Federal Communications Commission. In Japan and in Europe, state-owned telecommunications have been run directly by government ministries. These monopolies, considered as public utilities, generated little interest among users or government officials until recently. The explosive growth of information technologies over the last decade raises questions about monopolistic control of telecommunications.

Liberalization in telecommunications so far has involved varying mixtures of deregulation, de-monopolization and privatization of government-owned agencies. The situation varies from country to country.

In most countries, government authorities have monopoly on installation and operation of telecommunication facilities although they are empowered by law to grant concessions to private companies within specific telecommunication services such as radio, telephone, postal services, television, cable systems for distribution of sound and picture programmes, satellite communications, and transmission of data. In some countries, the administration may also allow outside users, on certain conditions, to connect their own equipment to the public telecommunication network or to the administration's equipment. Foreign suppliers may be subject to the same rules for connection of equipment as domestic suppliers. It is also argued that international cooperation in the interest of communication flows and standardization is facilitated if there is only one national administrator for each country. Further, the point is made that future technological facilities operating through an integrated network can be set up only under a single infrastructure. In Japan and the United Kingdom, the privatization of some public telecommunication services and the introduction of the principle of competition are being discussed or implemented. In Canada and in the United States, telecommunication services are provided by private companies in a framework of national and local regulations related to the installation and operation of all carriers.

A rapidly growing economic sector of considerable importance in terms of both industrial policy and technology policy is emerging with the combined use of telecommunications and informatics/computer services, or "telematics". The services concerned are commercially operated data bank and computer services, including the production of software as well as services that supplement, where they exist, public telecommunication services provided by the national telecommunication administrations. Some of these value-added network services, or vans, are subject to new regulations while some others are liberalized. For example in Canada, there is a requirement, applied to all banks, that data on banks' operations may not be sent outside the country for processing. Copies of the data may however be sent outside the country, e.g. to foreign bank head offices. In the same country, the law prohibits banks from offering computer services other than those related to banking. In some other countries, such as Japan or Switzerland, no law regulates specifically electronic data processing. However, it is also recognized that various provisions affecting the telecommunication sector may to some extent influence transactions in the computer services sector. In addition, the transmission of personal data across the border may be subject to privacy protection laws similar to the Council of Europe Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data. Other countries, like Switzerland and the United Kingdom, are preparing laws on the protection of information.

Concerning telecommunications and informatics/computer services, international coordination of standards, regulations and competition is developed in international organizations such as the International Telecommunication Union (ITU), the International Standards Organization (ISO), Inmarsat, Eutelsat and Intelsat. Work is also under way in several other fora on the handling of information flows over communication networks e.g. the Council of Europe (CE), the United Nations Center on Transnational Corporations (UNCTC) and the Intergovernmental Bureau for Informatics (IBI). In addition, the private commercial banks maintain among themselves a private, non-profit, cooperative society, the Society for Worldwide Interbank Financial Transfers (SWIFT), which operates international communication networks to serve the needs of the worldwide banking community. A new network, called SWIFT II, which will incorporate advanced data processing and telecommunications technologies, will work in June 1986 for banks in Europe, in 1987 in the Far East and in 1988 in the Pacific area and Latin America. Its new architecture will be based on decentralized modular processing units.

Today a number of current and potential problems can be identified in relation to international activities in telematics. Three main categories of measures are faced by companies: (1) measures related to international data flows, (2) measures related to competitive opportunities and (3) measures related to standards. The first category of measures cover measures prohibiting the inflow or outflow of certain kinds of information, measures raising the cost of transmitting information across national borders (regulatory or tax policies), possible taxation by state monopolies for the use of private leased lines on a modified volume-sensitive basis instead of a flat rate, and legislation restricting the use of computer facilities located abroad, either for data processing or for information retrieval.

The second category of measures includes prohibition of a majority shareholding in foreign subsidiaries of computer services firms, preferential tariff policies to promote use of public networks, limitation by state monopolies of the number of foreign suppliers of information services as well as the scope of services, e.g. the restriction of the shared use and sale of private line capacity, and possible limitation by state monopolies of the number of foreign providers of new telecommunication and information services not currently covered by existing state monopolies.

The third category of measures covers standards set up by governments for private telecommunication-related services that depend on public communication facilities, e.g. protocols cover the bit sequence of the introductory portion of digital messages. The choice of sequences required may impair the efficiency of foreign, as compared to local, equipment. This third category of measures also include regulations affecting the use of privately-owned equipment for connection to the public telecommunication network, e.g. limitations as to the type, make or design of equipment "acceptable" for interfacing with the local communications system.

At the same time, technological innovations and problems in the adaptation of regulations to new telematics services confuse world competition to a certain extent in view of the uncertainty and unpredictability surrounding the telematics environment. New and complex packages are emerging in the following high-technology services: communications satellite services (direct broadcasting to houses, corporate networks, mobile telephone and lease of transponders), and the Integrated Services Digital Network, or ISDN, when telephone networks will have evolved into sophisticated, general-purpose information networks, capable of carrying in digital form and at high speed any combination of voice, data and image into anyone's home or office whenever they want it.

Restrictions in telematics lead to increasing costs and reduced efficiency for firms which are forced to make sub-optimal decisions and develop separate facilities in different countries. Concern about future restrictions induces firms to postpone investments in telematics systems and facilities to the detriment of international trade and economic growth in general. Finally, restrictions have a distortive impact when they are in effect for some time, are based on earlier technology, and effectively bar the introduction of new types of services.

A policy framework on telematics should endeavour to minimize the risk of restrictive trends in telematics as well as to reduce the uncertainty faced by the trading circles, while not forcing governments to commit themselves in great detail on uncertain policy issues regarding the nature of innovation and technological changes in telematics.

Maintenance of 'open' exchanges, conducted under transparent procedures, is one of the essential conditions for expansion of the market in telematics, one of the principal bases of international economic relations, whether in the area of trade, finance or banking. Telematics exchanges should therefore continue to have a measure of freedom consistent with the needs of users - be they trading nations, private firms, businessmen, and ultimately any citizen in his day-to-day social relations. The Declaration, endorsed by the Ministers of the OECD countries in April 1985, represents the first international effort to address economic issues raised by telematics. Further work of a binding nature needs to be done.

* * *

Changes in trade patterns result from the interaction of many determinants. Some determinants have a momentum of their own, for example, ongoing technological change, or shifts in international competitiveness due to differing trends in wages. And some changes in shares are of a longer-term nature than others, for example, the rising shares of several countries in world trade, versus changes in shares due to exchange rate movements. On the other hand, the potential for the expansion of trade in particular goods and services is influenced by trade policies.

The policy determinants of trade patterns - that is, of changing country and shares in the world market - can also be examined from the viewpoint of the ability of countries to adjust to pressures for change. National trade policies clearly play a key rôle, with liberal trade policies promoting structural adjustment, growth and the competitiveness of the economy, which in turn leads to expanding exports and imports of goods and services.

The multilateral trading system plays a critical part in this process. When the system is functioning well - in particular, when it provides a stable and effective framework for the conduct of international trade - newcomers find it easier to enter new markets, injecting dynamism into the world economy as they expand their exports and imports. And the most-favoured-nation (MFN) principle ensures that all countries share in the growth opportunities offered by the permanently changing economic environment.

Telematics pushes the integration of the world economy further. Global issues imply a common challenge for favouring this integration process which would benefit Pacific nations as well as other nations all over the world. Since the area of world-traded services is one of rapid and continuous technological change, the politics should be directed at creating a stable general environment, rather than being concerned with narrow types of problems.

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The views expressed are the author's own and do not commit the GATT in any way.

TRANSBORDER DATA FLOWS: INFORMATION TECHNOLOGY & THE GLOBAL COMPETITIVE STRATEGIES OF MULTINATIONAL CORPORATIONS

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1. Abstract

Two classical explanations of the relationship between information and telecommunications technologies and the competitive strategies of firms are assessed with a view to expanding the discussion to cover the global operations of multinational corporations. Corporations may be inhibited from deploying optimum configurations of information technologies because governments have erected barriers to free trade in services, and have adopted some industrial policies to protect parastatal domestic corporations. The current GATT negotiations, in which trade in services will be a key item of discussion, pose inevitable questions for both developing and developed countries.

2.0 Classical Theories of Computers and Competition

2.0.1 It is being increasingly recognized that information technology and telecommunications systems which link together various geographical locations of firms are crucial to the development of business. Internal accounting, control of personnel, relationships with customers and suppliers, compliance with government reporting requirements, distribution of product or service, and monitoring of the external competitive environment -- each are examples of the ways in which information technologies are used by business organizations. Much recent writing has focused on "Computers & Competition" -- a popular phrase which embodies the idea that information technology can be used as a competitive weapon in conducting business. The most common example given to illustrate this emerging relationship between business strategy and information technology concerns a medical supply company which installed its computer terminals in the purchasing departments of its customers. Once the customers became used to the terminals, it became very difficult for other companies to sell to the same customer. Thus the medical supplier has gained a "strategic advantage" through the use of information technology.

2.0.2 These relationships between competitive strategy and information technology hold true for global corporations as much as for corporations operating within only a single national market. The rise in importance of multinational corporations in the world economy has highlighted the importance of international computer communication systems in the conduct of commerce. It should be recognized that just as in a national market, information technology can be used as a competitive weapon, on an international scale it can be used as well.

2.0.3 If it is true that information technology can give corporations strategic advantages in conducting business, then it follows that as multinational corporations conduct business in developing countries, the use of information technology is emerging as an increasingly important factor. In more information intensive lines of business, the role of information technology, including telecommunications systems, becomes even greater.

2.0.4 As scholarly attention has focused on understanding the dynamics of this emerging relationship, many ideas developed in classical business theory of competitive behavior of firms were applied to understanding the role of telecommunications and information technologies. This paper draws upon the thinking of two writers in this field, Charles Wiseman (1) and Michael E. Porter (2). Both writers have studied competitive behavior of corporations and the role of information technology in seeking and obtaining strategic advantages.

2.1 Porter's "Value Chain"(3)

2.1.1 Porter's analysis of the role of information technology in shaping competitive strategy starts from the idea that to be competitive, a firm must either minimize costs of producing a product or service, or maximize the amount the customer is willing to pay. He categorizes the functions of a firm into a type of input/output flow model in which inbound logistics, operations, outbound logistics, marketing and sales, and service (3) are the crucial functions. He then discusses how various types of software and hardware applications, such as computer-aided design (CAD) or telemarketing, can support these functions.

2.1.2 Porter notes that industries can be analyzed according to the information intensity of both their value chain and product, and that the industry competition as a whole is shaped by the power of suppliers and buyers, the threat of substitute products and the potential for the emergence of new competitors. Given these factors, Porter points to lowering of costs, enhancing differentiation of product and services, changing overall competitive scope of the industry and creating entirely new businesses, as the principal ways information technology can shape competitive strategy.

2.2 Wiseman's "Strategic Information Systems"

2.2.1 Wiseman has a similar view of the role of information technology. Wiseman defines "Strategic Information Systems" as computer systems which support or shape the competitive strategy of a firm.(4) In his study, Wiseman cites dozens of examples of the strategic use of information technology. He classifies the competitive use of information technology into several areas including: supporting a strategic change in business, helping with product differentiation, radically reducing costs, product or process innovation, aiding the overall growth of the industry through spinoffs, and alliances with other groups (such as suppliers or customers) to create better product integration, distribution or development.

2.2.2 Wiseman uses a simplified input/output model, similar to Porter's "value chain," and thereby highlights suppliers, customers, and competitors as objects of deployment of information technology. He emhasizes alliances with other industries, growth opportunities, product and service innovation and differentiation (in addition to cost) as being strategic functions of information technology.

2.3 Summary

2.3.1 Both writers have pointed out the emerging relationship between expansion and survival of corporations and their strategic use of information technology. Although they differ somewhat in their specific approaches and recommendations, each points out the need for managers to recognize the potential competitive advantages which come from strategic deployment of information technology. Both writers (and their colleagues) point to reduction of costs, improved (i.e. increasingly *automated*) relationships with both suppliers and customers, creation of entirely new lines of business, and radical changes in the way business is conducted, as being the focal points of how information technology is changing business.

2.3.2 The many real life examples given by each author demonstrate conclusively the reality of the emerging dependent relationship between information systems and the competitive strategies of firms.

3.0 Transborder Data Flows, Technology Transfer and the International Competition of Multinational Corporations

3.0.1 Writers such as Wiseman and Porter have described the competitive potential of information technology, but their theories *have assumed completely free mobility of information technology and telecommunications services.* Since *this condition is not present in the international arena*, their framework of analysis provides a convenient means of identifying some of the issues facing the international community.

3.0.2 The current theories of computers and competition assume that once the optimum competitive strategy is developed, there are few impediments to maximizing the use of information technology, i.e. once top management has decided to make the optimum investment, it is just a matter of carrying out the plans. For example, the decision to link together the computers controlling inventory, as it is distributed throughout several different countries, will inevitably carry much more complexity, regulatory snags, and difficulty, than the same decision applied to a single national market. Industrial policies adopted by various countries may prevent transparent borders, or may inhibit the optimum technological solution. If the difficulty of carrying out these strategies for deployment of information technology is sufficiently great as it is applied to the international scale, then the theory linking computers and competition should be revised.

3.0.3 In virtually every area identified as a possible locus of strategic utilization of information technology, multinational corporations may face constraints internationally. Cost reduction measures may not be easily obtainable due to taxes or rigidities in labor costs; product and service innovations may become difficult because of restrictions in using the newest and best equipment or telecommunication service. Technology transfer requirements may lessen the advantages from product innovation. Strategic alliances may be thwarted by host-country investment and ownership controls, and information technology-based rationalizations in managerial controls may prove fruitless in the face of in-country data processing requirements which prohibit or restrict transborder data flow.

Competitive Use of Information Technology	
Information Strategy	International Constraints
Cost Reduction	Taxes on Data Flow Taxes on Equipment
Product/Service Innovation	Prohibition of New Computer Equipment Technology Transfer Regulations
Strategic Alliances	Investment/Ownership Controls
Managerial Rationalization	In-Country Data Processing Requirements

3.1 The Cost Reduction Strategy

3.1.1 Even the classical line of thinking regarding utilization of information technology relies heavily on the automation of labor-intensive activities and a resulting cost-reduction in business operating expenses. The borderline between classical applications of information technology and strategic applications may not be clear, but both rely on flexibility of equipment acquisition, flexibilities in labor utilization, and low cost telecommunications.

3.1.2 In the international environment, multinational corporations may face taxes on telecommunications, or problems freely using the latest information technology. The lack of freedom in rationalizing telecommunications services, brought about by rigid PTT policies, can significantly harm cost reduction strategies. The multiplicity of possible networks available in the United States, for example, will not be available for quite some time, if ever, in most countries, particularly in developing countries. It has often been pointed out that for information-intensive industries, a rigid telecommunications market can eliminate large blocs of business (5).

3.1.3 Another factor which prevents full strategic use of information technology relates to import controls (including licensing, technical standards, and related factors) which prevent multinationals from freely using their own choice of equipment. In some countries, information technology can not be imported if a "reasonable substitute" is available in the host country. Since this is determined by the host-government, any hardships faced by the multinational in hooking together dissimilar equipment (and the extra labor costs, and time involved) are not considered. Companies may many times face great delays in getting government approvals for importation and utilization of equipment. Equipment may occasionally be so heavily taxed as to out-weight any possible advantages from "strategic" investment. These procedures for licensing international flow of information technology take a heavy toll, not only to multinational corporations, but to the government bureaucracies which must keep control.

3.1.4 In light of the integral part information technology plays in world commerce, it might be asked whether these types of controls are necessary at all?

3.2 Product/Service Innovation

3.2.1 Innovations in products or services delivered to the marketplace are another important area often cited as a fertile locus of strategic investment in information technology. Organizations may find, for example, they have an internal database which can be sold profitably on the open market. Information technology may enable the creation of entirely new avenues of delivery, and the creation of products customized for each potential customer. It might be possible for customers to be electronically linked with the company computer.

3.2.2 Any product innovation may be compromised by prohibitions on the free flow of technology. If corporations are not allowed to freely import and use information technology on an international scale, then product innovation will slow. Technology transfer regulations may make it impossible for the innovative company to reap the benefits from innovation. If these regulations and controls are host-government policy, there is little that can be done. But the situation may be quite different from the assumptions of Wiseman and Porter.

3.3 Strategic Alliances

3.3.1 A third competitive use of information technology may lie in the seeking of strategic alliances with other economic entities. Distribution companies may link together their computers, or entirely new lines of business may be acquired.

3.3.2 Many countries have investment and ownership controls making this type of strategic move impossible. Regardless of the potential benefits to either the host-country or the multinational corporation, government policy many times insures local ownership of many industries which are considered to be "strategic." In many countries, the definition of "strategic" may be so broad as to make acquisition impossible. In other cases, strategic alliances may be difficult or unprofitable since parastatal organizations both comprise the bulk of alliance possibilities, and hold monopolistic market positions.

3.4 Managerial Rationalization

3.4.1 The use of telecommunications-intensive forms of *data processing, such as distributed processing, has brought* about the possibility for instantaneous global communication and managerial control. Changes in technology may have profound implications for managerial structure, reporting relationships, and control strategies. Not only is management control at stake, but the *entire information process of business operations*, is a candidate for revolutionary change. If, for example, all information from a corporation is available at all geographical points, at all times, at a low cost, then the manner of business operations will quickly change. The era of true global management is already here in many financial markets, and will gradually expand to include more sectors of the world's economy.

3.4.2 Controls on transborder data flow, purchasing and utilization of information technology, or other forms of rigidities, will substantially hinder this type of global rationalization. The requirement that some data processing be done only within national borders is an example of how rationalization can be inhibited by government policy. It is difficult to calculate the underlying economic costs, but should these types of policies become universal, they will not be insubstantial. The natural tendencies towards efficiency and speed in international business will be repressed. Strategic investment in information technology for these purposes can not succeed in face of these barriers.

4.0 The GATT Negotiations on Trade in Services -- Questions for Developing Countries

4.0.1 There are as yet (November,1985) no scheduled GATT negotiations on international trade in services. Some developing countries, led by Brazil and India, have demanded that developed countries, *prior to the start of negotiations on trade in services*, agree to reductions in barriers against trade of goods flowing from developing to developed countries. The United States has adopted the position that no preliminary conditions should be accepted before negotiations start, but that everything should eventually be negotiated. There has been agreement to begin work on a negotiating agenda. It is clear that the idea of trading concessions in services for concessions in goods is being rejected by the developing countries. They have argued that the current restrictions to trade in goods are not consistent with the spirit of GATT, and therefore they are being asked to give concessions in trade in services in exchange for concessions regarding trade in goods which should already be freely traded.

4.0.2 The United States has realized that its services sector is more efficient than those services protected behind state imposed barriers in many developing countries. Developing countries have realized that in many goods sectors, their industries are capable of grabbing market share in the United States. The trade-offs between these two positions will dominate the GATT discussions in the coming few years.

4.0.3 The current GATT discussions will determine the degree to which multinational corporations will be able to adopt optimum strategies for competitive deployment of information and telecommunications technologies. This is particularly the case with information-intensive industries, such as banking and insurance. If the recent rapid slide in market share for Dutch banks in their own market, caused by the competitive information-based thrust of U.S. banks, is any indication, then it should be clear that should liberalization of services take place, protected parastatal organizations in many countries will lose market share. Once their protection is gone, they may well find it increasingly difficult to face the competition from service industries based in developed countries. Developed country information-intensive industries which have had a chance to freely adopt sophisticated telecommunications and information technology strategies will have substantial advantages.

4.0.4 Another factor is that since information-intensive industries have highly mobile factors of production (information), then reaction times will shorten, and competitive advantages will be achieved much faster than would be the case should heavy investments in areas such as capital equipment, raw materials, or transportation networks and physical infrastructure be necessary. In light of these factors, several questions are raised for developing countries:

4.1 Questions for Developing Countries

4.1.1 Will the Information Age result in the same negative terms of trade as the industrial age did for developing countries?

4.1.2 How can developing countries develop their information technology and telecommunications infrastructure without protectionism?

4.1.3 Should international trade in services be liberalized under the GATT, then what kinds of protections (if any) are needed to prevent the collapse of parastatal enterprises?

4.1.4 What forms of regulations are needed to control the activities of multinationals within host-countries?

5.0 Summary

Multinational corporations have found that within certain relatively free markets, information and telecommunications technologies can be used as competitive weapons in the struggle for business. However, due to restrictions in trade in services, including telecommunications, in the international arena, these same companies are prohibited from using information technology to its fullest potential. Should the GATT negotiations liberalize trade in services, and should liberalization take place in liscensing for utilization of information technology, then computer communication systems will become a global force shaping the world economy.

NOTES

1. See Charles Wiseman, Strategy and Computers: Information Systems as Competitive Weapons, (Homewood, IL: Down Jones-Irwin, 1985).

2. See Michael E. Porter, Competitive Strategy: Techniques for Analyzing Industries and Competitors, (New York: The Free Press, 1980), especially Chapter 13 "Competition in Global Industries", cited as "Porter A". See also Michael E. Porter and Victor E. Millar, "How Information Gives You Competitive Advantage," Harvard Business Review, July - August 1985, PP. 149-160, cited as "Porter B"

3. Porter A, pps. 151, 153. The basic concept behind the "value chain" appears to be a determination of what match exists between on the one hand the underlying informational structure and communications flow of a firm, both internally, and externally as it relates to the outside world, and on the other hand the specific computer software and hardware applications supporting the information paths and processes. Thus Porter matches "Telemarketing" as a information technology and telecommunications application with "Marketing and Sales," a traditional step on the "value chain" of the corporation. Porter's methodology conveniently allows one to map any potential application of information technology with a corresponding business function, and thereby determine the potential role of the application in the overall business role of the firm.

4. See Wiseman, Appendix B, pp. 229-236.

5. If elasticity of demand of the service or product is highly sensitive to price, and telecommunications charges form a large portion of final price to consumer, then the market penetration of the service or product can be virtually controlled by manipulating prices in telecommunications services. This consideration is less important for less information-intensive industries.

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Notes

ARTIFICIAL INTELLIGENCE AND COMMUNICATION

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I. Introduction

I yearningly remember my younger age of more than thirty years ago, when the telephone exchange was done by human beings. We did not dial numbers, but just picked up the receiver and told to our familiar woman telephone operator in the following way. "Hello, how are you. I want Dr. Kato, a dentist. I have a heavy toothache." Then the operator answered me: "Hello, Mr. Nagao. It is too bad. Cannot you stand the toothache at all? Dr. Kato is absent today. I called him up just a moment ago, and found him absent until the day after tomorrow. Shall I connect you to Dr. Sato? He is also a good dentist, as you know." Then my answer was, of course, "Yes, please. It is very kind of you."

I have a nostalgia to such a humanistic village telephone operator. We were not forced to memorize meaningless dial numbers. We obtained useful information of the village from the telephone operator sometimes, such as the sudden death of Mr. So-and-so. Good old days!

Today, we have to dial ten digits, or more. We have no capacity in the brain to memorize such long numbers. Telephone directory service system is always busy in a big city like Tokyo. The inquiry line is always busy, and we have to retry the line several times until we catch a service operator. Service operators ask us lots of questions about the man whom we want to talk, such as the spelling of the name, the exact address, and even his occupation sometimes. All these must be exact. Otherwise, service operators can not give us the correct number. We have to be patient. We have to wait for long minutes, and finally get the number. Why the operators are not kind enough to connect us to the destination which we want to get through, instead of answering just the phone number? We have to make a note of the telephone number told by the service operator, and to dial the ten digits again! Cannot we get the wonderful telephone exchange service of good old days? Why not, in this modern world of advanced technology?

II. Artificial Intelligence

Artificial intelligence (AI) aims at the realization of human intellectual activities by machine. It aims at solving difficult problems by a computer program as a man solves it. It searches many possible pathes by trial-and-error processes to reach a solution. It tries to recognize human speech sounds as a man understands them. It reads characters written on a paper, and recognizes familiar objects in a picture. It tries to analyze and understand natural language, and to translate sentences from one language to another. It utilizes databases and knowledge to infer useful results.

Artificial intelligence has been studies for about thirty years, and many useful results as well as basic methodological achievements have been obtained. We are now in the age of applications of AI, although there remains lot of difficult problems to be solved in the future.

III. Speech Researches

Let us see the state-of-the-art of speech researches, which have a longer history than AI. There exist already several speech recognition devices in the market. These can be divided into two categories. One is the system which recognizes the spoken words of specified persons. The systems of this category can recognize about five hundred words by more than 90% accuracy. The second one is the speech recognition of unspecified persons. In this case only a few tens of words are recognizable at the present technology. It is quite difficult to increase the number of recognition words. In both cases the utterance must be made clearly word by word with a short pause between them.

To make the technology of speech recognition practically usable in wider situation, much more fundamental researches are required. But by considering a new system's concept a practical speech recognition system will be realized for unspecified persons in the following way. That is, we give the feature parameters of a speaker to the system just before he speaks, and tune the recognition system to his speech sound. We can think of a memory card of a very small size which contains all the private information of the card holder, including his speech features. We may call this card as privacy card. When he wants to use the speech recognition system, he inserts his privacy card to the system (or to a telephone terminal he is going to use). Then his speech features are read into the system, and the system becomes adapted to his voice. In this way the speeches of any person will be recognized sufficiently well. The system of this kind can be realizable soon.

Speech synthesis or generation is much easier compared to speech recognition. There are many practical systems used everywhere. A problem here is the attachment of naturalness to the speech sound in a sentential utterance, such as proper accent and intonation, according to contextual information and the emotion of the speaker.

IV. Natural Language Processing

One of the most important research topics of artificial intelligence is the analysis and understanding of natural languages, because most of the brain activities are usually reflected by language behavior. Computational approaches to language have been making a steady progress during these thirty years. Language analysis can be roughly divided into the followings: morphological analysis, syntactic analysis, semantic analysis, discourse analysis, and language understanding. From the technical standpoint, we have verv few problems in morphological analysis. We have several models for syntactic structures of a language, such as phrase structure grammar, generalized phrase structure grammar, lexical functional grammar, augmented transition network grammar, and so on. All these are implemented as computer programs and used widely. A problem here is the establishment of a standard set of grammatical rules for every language in either form of grammar systems. At Kyoto University we have written a fairly extensive set of Japanese grammar rules of about one thousand for use in our machine translation system between Japanese and English.

Semantic analysis is not so easy as syntactic analysis. There are several approaches to semantics, such as word semantics, sentential semantics, truth-conditional semantics, and so on. For machine translation systems, word semantics is important. A few tens of semantic primitives are generally established to describe word meanings by the combination of these semantic primitives. We have about fifty semantic primitives in our machine translation system. Our machine translation system depends on the case grammar, which watches the behavior of the verb. Case structures with semantic specifications to each case position are given to each verb usage. The case grammar plays an important role in the analysis of the Japanese language which is rather word-order-free, and in the analysis of the spoken sentences which always lack important phrases owing to the contextual influence.

Truth-conditional semantics is to know whether the content of a sentence (that is, meaning) can be interpreted as true or not from the knowledge denotated by the components of the sentence. For example, "the sun rises from the east." is true, or has a meaning, because the sun rises from the east, and the interpretation of the sentence becomes true from this fact. This approach to semantics is useful for a dialogue system. Man-machine conversation system will become more and more essential in the future, and the mechanism of a dialogue is to be studied more intensively. Truth-conditional interpretation of a dialogue is very important.

Dialogue System

The study of discourse and dialogue mechanisms has been started recently. There are many interesting papers appearing now, and we have to wait for the future for a fruitful result. There is still no computer program which incorporates the discourse models sufficiently, except an imperfect model for the pronoun references and elliptic expressions.

There are many trials to language understanding models by computer. One of the most famous experiments was the one demonstrated by Winograd in 1970. However, his model treated only a very narrow topic field. And it was estimated very difficult to enlarge the conversational field to much wider areas. Since then there is no significant work unfortunately. The reasons are presumably that there is no consensus for the meaning of "understanding", and that the understanding requires a huge amount of knowledge and a strong inference mechanism as its prerequisite, which are quite difficult to realize by the present-day artificial intelligence technology.

Dialogue systems between man and machine will become very important in the future communication systems. People do not know everything exactly, and they pose lots of questions in a redundant conversational mode. The system has to cope with any utterances of a man, and must give proper responses. ELIZA was the first dialogue system with shallow inference ability. Today we have to have much more advanced mechanisms for a friendly conversation between man and machine. We have to have a good reason to choose a response from a good many possible answers like the followings.

"Hawaii has changed a lot".

⟶ When did you come as the last visit?
⟶ Haven't you come here for a long time?
⟶ Yes, it is. When did you arrive here?
⟶ Yes, every resort place has changed.
⟶ Yes, and Tokyo too.
⟶ Yes, especially this Waikiki district.
⟶ Well, not so much, these few years.
. . . . . .

Conversation depends heavily on the shared and non-shared knowledge of the pair of speakers, and on the circumstance when and where they are. Cooperative researches among linguists, psychologists and computer scientists are essential for this difficult problem.

V. Database Access by Natural Language

However, there are many practical applications based on the results of present-day dialogue and language understanding researches. These are so-called natural language interfaces to database systems. Natural language queries are analyzed and interpreted by the knowledge of database structure and its contents, and a proper response is given either as a result of database access or for the purpose of obtaining more precise specification of the man's request. For example, let us think about an inquiry of a telephone number to a telephone directory database. We can ask "Let me give the phone number of Yamada's school, please". This phrase, however, can be interpreted in several different ways such as follows.

(1) The telephone number of the school which is directed or owned by Yamada.
(2) The telephone number of the school where a friend, Yamada, goes to as a student.
(3) The telephone number of the school in the town called Yamada.

If the database contains the relational information of the enterprises and their owners, the interpretation (1) will be adopted by the system. If the database contains the relational information of the schools and the student names, then the interpretation (2) will be adopted, and so on. In this way the interpretation of a query sentence and a response will depend on the internal knowledge of the system. If the system contains several different databases as the knowledge, the query sentences must be interpreted by using contextual information, or by asking back to the client from the system in order to disambiguate the meaning of a question.

We can think of an intelligent telephone exchange system by the combination of useful databases, language analysis and inference ability. Here is a simple example.

> I (Mr. A) have to meet Mr. B in New York. ⟶ When ⟶ Mr. A has to go to New York on January 20. ⟶ Where is New York. ⟶ Mr. A must take an airplane. ⟶ Mr. A must make reservation of a flight of January 20. ⟶ Reservation of a flight can be made by a travel bureau. ⟶ The nearest travel bureau is C. ⟶ Mr. A must make a phone call to the travel bureau C. ⟶ Mr. A must get the phone number of C. ⟶ . . . . .

If the system is intelligent enough to guess a user's wish in this way, it will immediately tell Mr. A that he can fly to New York by the flight #123 on January 20, which leaves San Francisco Airport on 9.00 AM. And it will ask him whether he will make reservation to that flight, and so on. Such human-like consultation system is not a dream in the near future. This is AI. In this way, a telephone network is not only a communication media between men, but also is a wonderful information source for a man to ask any questions and demands.

VI. Machine Translation

Researches on machine translation has also a long history. It began shortly after the invention of digital computer around 1945. A big first step was made during 1955 and 1965, mainly in the US. Syntactic parsing was the main concern during the period, and a few experimental systems produced translation results. However, no system satisfied the actual demands from the customers, and the research activities decayed at the middle of '60. But the survival has come in Europe and Japan since a few years ago. In these countries language barrier is a serious problem which hinders the activities in economics, politics, science, technology, and others. To ease the difficulty the researches and developments of machine translation systems have been initiated intensively. In Japan there are several basic researches at the academic circle, and many developments at private industries. Few systems have been announced in the market, which translate sentences between Japanese and English. In one or two years major computer companies in Japan will all sell their machine translation systems, which range from a big high speed production systems to small personal uses.

The present level of machine translation systems, although they use semantics to a certain extent, is not high enough to satisfy wide usages. The translation is done sentence by sentence, with almost no contextual treatment. The translated results must be corrected by a post-editor. Still, there are many user companies which want to introduce a machine translation system from a point of view of higher translation speed and cheaper cost (including the post-editing) compared to the human manual translation. The systems will be improved step by step by the feedback from the user's experiences, and much more refined systems will be produced in the future.

In view of the importance of machine translation, the Agency of Science and Technology of Japan took the initiative of developing a reliable machine translation system which translates the abstracts of academic papers in science and technology between Japanese and English. This governmental project started in 1982 and will be completed in March 1986. The development is being conducted by the research staffs at Kyoto University, Electrotechnical Laboratory, Japan Information Center for Science and Technology, and Research Information Processing System. They have developed a fairly sophisticated algorithms for the structural and semantic translation between Japanese and English, which are essential for the language pairs belonging to totally different language families.

In European Community language barrier has been a serious problem for a long time, and they finally determined to start EUROTRA project in 1982. It aims at the development of a multi-lingual machine translation system which, when a sentence in a language is given, translates it into several other languages simultaneously. Many university researchers in EC countries are developing a system in cooperation. It will produce an initial trial translation in the next two years.

VII. Telecommunication System with Machine Translation of Speeches

In view of the recent advancement of speech researches and machine translation, and to promote an advanced technology in telecommunication and information processing areas, the Ministry of Postal Services has started a committee which investigates the feasibility of practical telecommunication system with machine translation of speeches (TCSMTS). We will have an international idealistic society where we can make phone calls to hotels, department stores and so on in a foreign country by TCSMTS in the twenty first century. If TCSMTS is fabricated very small, we will carry it to foreign country as a simultaneous translation facility.

TCSMTS will be composed of such subsystems as speech recognition subsystem which can be adjusted to speakers, language analysis subsystem which understands imperfect or ungrammatical sentences, machine translation subsystem, and speech synthesis subsystem. The system must be able to extract such information as sex, age, social status or position, mental state, and so on of the speakers. Such information must be obtained from the speech sound of the speakers as well as from the privacy card which must be inserted to the terminal of TCSMTS before the usage. The system development is quite difficult, but an interesting problem to solve in linguistics and artificial intelligence. The research and development of this system must be painstaking and require a long time. We may have to limit the style of utterance, that is, to control the input sentential forms. Speakers may be trained to a certain extent, with his speech parameters given to the system to realize high recognition rate. International cooperation is essential for the development of TCSMTS, and it is worth doing.

VIII. Dictionaries, Databases, and Knowledge Bases.

In every system so far explained, dictionary is essential as a part of the system. In speech recognition system, we have to accumulate speech sound data of all the words in the dictionary, which requires lots of money and a long period. In machine translation systems we must prepare word dictionaries for analysis, transfer (from one language to another), and synthesis. The information to be written in these dictionaries is linguistically quite sophisticated, and requires many highly trained personnels in linguistics and information science. Here again international cooperation is required.

In the future society information systems will be heavily used for varieties of purposes. These systems, therefore, must give different kind of services by the combination of databases and inference machines. The construction and the maintenance of the databases become a big problem. The databases will be distributed widely all over the world, and still the system must give flexible services as if these distributed databases are unified into one total system.

There are different kind of databases, from simple to complex. Formatted numerical data is the simplest. Formatted character data and text data will not be so simple. Unformatted text data will be quite difficult to handle. Sophisticated linguistic and non-linguistic processing is required to extract useful information for the customer's demands. Speech data and image data must also be handled by the future information systems. No powerful technologies are yet developed so far to handle speech and image data by their inherent properties and meanings.

For a flexible question answering a system has to have information like knowledge in the human brain. There are some efforts to represent this kind of information in the computer, which is called knowledge base researches. This is just started. This must be studied as a very long term research for the practical usage.

IX. Expert Systems

One of the big applications of artificial intelligence is an expert system, which accumulates expert's knowledge and behaves like a human expert in a field. For example, MYCIN is an expert system which receives patient's body information, judges the condition of the patient, and gives back the prescription for him. MYCIN works very well in a very restricted field of infectious diseases. Generally speaking, an expert system is composed of a knowledge base and a strong inference engine, with some additional facilities like explanation functions and knowledge acquisition functions. The way of representing knowledge in general is quite difficult, and no good method is obtained yet. However, the representation of knowledge by condition-and-action pairs is useful in the ordinary expert system, and is widely used. Expert system can be constructed for almost all the difficult problems which a human expert can handle, but for which no definite algorithms are discovered.

Nowadays there are many huge systems, the detailed mechanisms of which are not grasped by any single person. Therefore when a trouble happens it is quite difficult to clarify the reasons and to locate the trouble sources. There often happens in such a huge system the accidents which have never appeared before. To cope with these troubles lots of information about the system must be accumulated and utilized in an expert system by the form of cause-effect pairs which can be derived from the system design knowledge, and also can be obtained by expert maintenance people. Such "help"-expert system is indispensable in a big system to minimize the damage by troubles and to recover the system as quick as possible. Human experience and knowledge are weak and almost useless in extreme shock conditions. Artificial intelligence will be especially valuable in such situations.

At Bell Laboratories an expert system which diagnoses the subscriber's telephone lines is developed, tested, and is proved to be usable in actual situations. Telephone exchange system is a big system, and when it gets in trouble, the recovery operations are quite complicated. An expert system will be able to suggest the operation sequences to take according to the state of trouble the system is involved in.

Expert system can be constructed not only for the system maintenance problems, but also for the training of maintenance operators, future planning, and so on. One of the difficult problems in constructing an expert system will be the size of the problem to handle at a time. If it is large, it becomes quite difficult to accumulate effective system's knowledge which will be huge, and to get an effective answers quickly. If the size is too small, it will not be useful in practice. We have to accumulate experiences for effective expert system construction.

X. Conclusion

The concept of communication by telephone has been changing dramatically by the advancement of information technology and artificial intelligence. By connecting large databases, powerful inference machines, and information processing facilities, such as speech recognition and synthesis systems, character/image recognition and generation systems, and natural language understanding systems, to the communication network, we will certainly be able to enjoy the service of that wonderful village telephone exchange operator of good old days. Moreover, we will be able to make telephone calls to any country in the world through machine translation, and to ask anything to the databases in that country. I hope this is not a mere dream of a night.

Value Added Networks - New Opportunities

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The information age is happening through the marriage of information processing and telecommunications. Information processing, which has matured in a competitive environment, has provided price/performance benefits unequaled by any other industry. Governments are re-evaluating their telecommunications policy, investigating the possibility of gaining similar benefits in telecommunications through competition.

The fastest growing segment of the information industry today and for at least the forseeable future promises to be value added networks (VANs). Yet many countries have yet to adjust their telecommunication policies to allow for the competitive provision of VANs.

Only through the emergence of many VANs, both domestically and internationally, will countries get the maximum utilization of their basic telecommunications network, allow competitors to tailor a multitude of services for users and provide telecommunications environments attractive to the service industry and other industries who are dependent upon timely, efficient access to information.

The Information Age. What is it? Why is it happening? Is it important?

Let me try to answer these questions starting with the third one first. Yes, it is important. The information industry which forms the basis of the Information Age is not only important in its own right; its development and proper utilization will determine the success of many of our business ventures, how we educate our youth and the very structure of our society. Estimates of the information industry's annual revenue put its size close to $500 billion dollars today, growing to over $1.7 trillion dollars in the next decade.

What is the information age? We entered it when information became the major underlying factor powering developments in our society. In the past, land, energy and capital have in turn served as engines for our society. Today, the information industry is the motor. It is unique, of course, in that its resource, information, is not consumed as it is used.

The Information Age is happening because of the growing interrelationship between information processing and telecommunications. The development of microprocessors combined with the digitizing of networks has brought these two industries close together and made them interdependent. The advent of the personal computer and the wide availability of transmission capacity have brought users the ability to store, process and instantaneously access and transmit information around the globe.

Speaking of speed, it reminds me of the story of the owner of a race horse who was in the paddock area with the jockey prior to the race giving the jockey some last minute instructions. As he was talking, he put his hand in his pocket and took out a lump of something and gave it to the horse. At that very moment the track steward came around the bend, and having seen this told the trainer that he would have to disqualify the horse because it had been given something to eat just before the race. The owner protested and to show the innocence of his move told the steward it was just sugar and popped a cube in his mouth. The steward, still not convinced, demanded that the horse be scratched. The owner again protested and gave a cube to the steward, who upon eating it decided that maybe it was just an oversight on the owner's part, he admonished him not to do it again and allowed the horse to be in the race.

The owner then turned to the jockey with his instructions on the race and told the jockey "You should get the lead in the race and halfway through should have a comfortable four length lead. Coming into the stretch you should be lengthening your lead and if you hear any footsteps behind you don't turn around, it's just the steward and I."

As I will discuss today, if we are to keep up with the pace of change in the Information Age, we may have to change our diet to stay in the race. Change the diet from one that has relied on regulation in many areas of telecommunications to competition.

The two industries, information processing and telecommunications, have grown up in two different environments. The information processing industry has essentially always been competitive while the telecommunications industry has been characterized by regulated monopolies. And now in many countries, national telecommunication policies are being reconsidered because of a belief that perhaps the competitive provision of telecommunications products and services will provide the same price/performance benefits that have been characteristic of the information processing industry.

The price/performance track record in the computer industry have been truly outstanding. As few as thirty years ago a typical data processing operation cost more than $14 and took more than 6 minutes to complete. Today that same operation costs just four cents and takes less than a half a second. That's 364 times as cheap and 930 times as fast. Now those are significant numbers, but rather abstract. Let me try to bring them closer to everybody's experience. In the past 30 years if technology had improved airplanes as much as it has improved computers, you could fly from Hong Kong to San Francisco in less than 2 minutes for less than $2. Or if technology had improved automobiles as much as it has improved computers, you could drive a mid-sized car around the world on 8 liters of fuel.

This tremendous advance in price/performance has produced the following results:

- the number of computers installed worldwide has grown from a handful to greater than 17 million
- the number of companies in the industry has gone from about a half a dozen to more than 15 thousand
- the business has grown from a few million dollars to greater than $300 billion dollars
- it's an industry today that has worldwide investments of more than $200 billion dollars in plants, equipment and other assets
- it has provided some 4 million jobs for people on every continent and produces a world trade volume of nearly $50 billion dollars

In short, the information processing industry is characterized by creative competition where innovation produces rewards for the consumer as well as the innovator. If we are going to continue this kind of progress, competition must continue to govern the information processing industry and to realize the full potential of the Information Age, we must also unleash competition in major areas of telecommunications.

This means we must reexamine and challenge any entrenched historical views that prefer regulated monopoly to market competition because competition will also power new growth in telecommunications. Telecommunication networks are the highways over which the Information Age will travel. What is needed are enlightened telecommunications policies which will allow for the maximum use of these highways for the benefit of the end users.

This leads me to the main topic I want to discuss today - value added networks - networks which utilize transmission highways to deliver applications to end users. Only a few countries allow VANs on a fully competitive basis. In fact, only Canada, the United States, Japan and the U.K. have adopted policies which encourage open competition for value added networks. Yet these VANs offer tremendous opportunities to fill the capacity of the new transmission highways being built today using fibre optics, cable, and satellite systems.

A Value Added Network consists of leased circuits obtained from a carrier, computing power to add value in processing, specific application software and terminals on user premises. Over the next 5 years competitive VANs in the countries I mentioned will grow at a rate of greater than 30% and by 1990 will be a $5 billion business. The largest segment of this market is in the United States, followed by Europe and then the Far East.

I would like to make three premises regarding the competitive provision of VAN services and then try to back up each with some rationale. Through the competitive VAN marketplace, benefits will flow to all stakeholders:

1) To the telecommunication provider who will greatly increase the utilization of his network which is the highway upon which the VANs move information.
2) To the end users, who utilize the new services to conduct their businesses, in a more cost efficient, productive basis.
3) To the VAN suppliers who will provide new employment and business opportunities as they compete in the marketplace.

First let's look at the telecommunications provider. If the only choice is to have a sole provider of value added network services, then the utilization of the network will depend upon this one offering and its ability to meet the many requirements of end users. The alternative is to allow open competition in VANs. Having numerous firms utilize the underlying network will inevitably increase the network's overall utilization and provide the carrier the associated increased revenues.

A quick look at those countries that have allowed competition in VANs will show the demand users have for a variety of VAN offerings.

- The value added network service business in the United States is today about $300 million dollars annually growing at over 40% per year. By 1990 it will be a $2.6 billion business.
- In Canada, competition is just starting to emerge.
- In Japan, while the competitive provision of VANs is still new, already as of October of last year, 180 companies had filed for special licenses.
- In the U.K. over 166 firms have registered under the VAN general license.

For these competitive offerings, the underlying transmission of the carriers will be utilized. Therefore, the telecommunications agency will more efficiently use its capacity to provide not only basic telecommunication services but also for the numerous value added network service offerings.

Moving on to the next point, I don't think I need to belabor the benefits to the end users who will be utilizing these new services. No banker needs to be told how financial services today are dependent upon communication networks. Applications in the fields of medicine and science, not to mention hotel and airline reservation systems depend on VANs to communicate. Businesses are constantly extending their enterprises through networks directly to their suppliers and to their customers in order to be more productive and meet the ever changing needs in the competitive marketplace. The ability of firms to utilize information is as strategically important today as their skills in manufacturing, marketing or finance.

Finally, on the third point, many new business and employment opportunities will develop from the competitive provision of VANs. Today, in the U.S., the information services industry has approximately 1800 data bases available, up from less than 400 just eight years ago. These are offered by almost 400 vendors serving almost half a million customers. In the U.K., Japan and Canada each licensee will produce jobs and develop applications to further the productivity of its customers.

These numbers indicate the diversity of the market and the demand to have many different offerings to meet the varied requirements of customers. While still in its infancy, the VAN industry is characterized by creative competition where innovation produces rewards for the consumer as well as the innovator; competition that encourages change and permits market forces to reward and discourage.

There are, of course, those today who have a vested interest in perpetuating the monopoly provision of VANs. There are others who would like to slow the pace of change even though they see its inevitability. But the penalties of perpetuating obsolete regulation can be serious. They can undermine a nation's competitiveness and deny the benefits of competition and its advancements to its people.

In conclusion, I believe there is today a major opportunity for countries to welcome the Information Age by relying on the competitive provision of value added networks for the wide variety of services the marketplace requires.

Many smart companies today are demanding to be given the freedom to use new information based applications provided by VANs to gain a strategic edge on everything from product development to marketing. Whether a company wants to extend its network by reaching out to consumers or back to suppliers; or communicate with its peers to move money or process information, the demand will exist for networks which, through a variety of application packages, add value to their businesses.

As active participants in your country's telecommunications policy discussions I urge you to speak out regarding the opportunities that value added networks offer and by advocating their competitive provision, help bring the benefits they, as part of the Information Age, can make available. Be like the rooster who approached the hen holding an ostrich egg for her to see, "I'm not criticizing or belittling your efforts" the rooster told the hen, "I just wanted to bring to your attention what others are managing to accomplish in this area."

USE OF COMPUTER PROGRAMS TO ANALYZE 10 DIFFERENT CONFIGURATIONS FOR THE DIGITAL TANDEM NETWORK IN THE CITY OF TAIPEI SERVING 2.8 MILLION SUBSCRIBERS IN THE YEAR 2000

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Abstract

The Directorate General of Telecom in Taiwan and the GTE Taicom company of Taipei have prepared toghether an optimization study of the Taipei City network forecasting the complete digitalization of the network by the year 2000.

The input of the study was the present traffic matrix and the subscriber projection until 1999. On the basis of such information a complete forecast of traffic matrix has been generated for the years 1988, 1993 and 1999. The purpose of the study was to create by the year 1988 a digital tandem infrastructure minimizing the use of analog junction circuits, increasing considerably the level and quality of the network with maximum use of fiber optic cables and digital tandem switching.

Ten different alternatives for the configuration of the network have been examined in each of the years 1988, 1993, 1999. A solution which includes 9 digital tandem has been selected on the basis of the annual charge calculation, subdivision of traffic among various tandems, alternate routing capability and maximum utilization of the existing cable plant. In addition the cost of the conversion of the junction network from totally analog to totally digital has been estimated.

1. INTRODUCTION

The network model for the Great Taipei area was completed using a series of developed network planning computer programs. These programs develop community of interest factors which provide a method to project trunk forecast and other matrices out into a long range planning frame: 15 years. They also are used in an iterative process to identify the most economical network configuration.

The normal operation of these programs is dependent on the completeness and accuracy of basic data available on the existing network and on the planned expansion of the subscribers during the 15 year period considered. Because of the high quality of the data available in a long term planning studied previously by the Northern Taiwan Directorate General, the set of reports are considered to be a high quality and representative of Taipei´s long range network plan.

This plan is not a day-to-day guide for how the quantity of trunks between exchanges is to be calculated; quantities will change, because the development of the traffic forecasted now does not correspond to the reality 5, 10 or 15 years from now. But the configuration of the network optimized today will be valid for many years ahead.

2. THE BASIC PRINCIPLES FOR THE INTRODUCTION OF DIGITAL EXCHANGES IN AN ANALOG ENVIRONMENT

Two basic principles have been introduced in the optimization of the network:

- Create a PCM ring
- Overlay a parallel high traffic network to the existing analog network.

In fact the optimization of the network is taking into consideration the plan already prepared and approved to introduce digital terminal exchanges. The optimization assumes that it is essential to create digital tandem exchanges prior or at the same time the terminal digital exchanges are put in service. Even though digital terminal exchanges are less expensive than analog ones, the interface of the new system with the existing analog is expensive until the digital environment has reached at least a 30-50 percent. And the analog to digital converters represent a very short term investment.

3. THE PCM RING

One of the most used configuration to minimize the analog to digital interconnection is the "PCM Ring". This configuration which is illustrated in figure 1, creates a mesh in a large metropolitan area among all tandem exchanges, with a star connection to every tandem of some of the terminal exchanges either analog or digital. All traffic between two terminal exchanges will have direct trunks only if the traffic economically justifies a direct connection. Otherwise the traffic will transit through a digital tandem exchange. The use of the PCM ring allows considerable savings of trunks for the same traffic: in addition, the conversion of the terminal exchanges from analog to digital can be orderly planned.

THE PCM RING

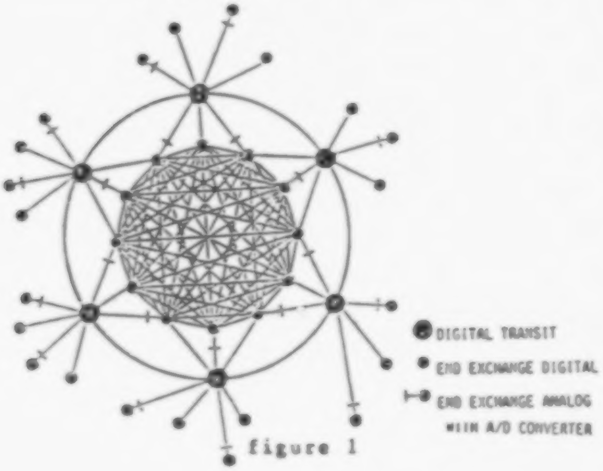


figure 1

4. OVERLAY OF A HIGH TRAFFIC DIGITAL NETWORK.

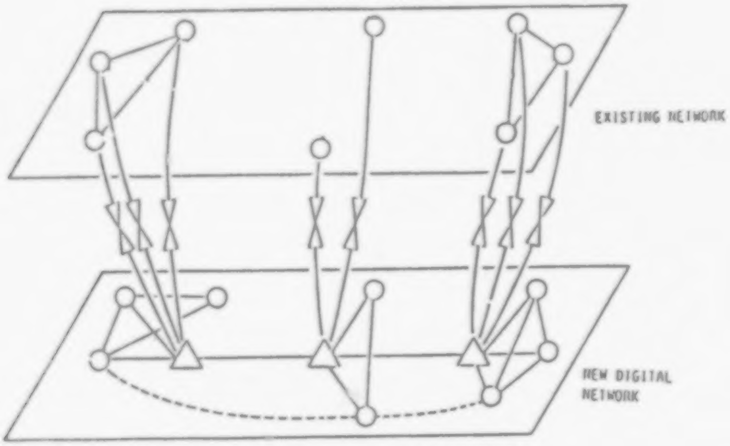
The other methodology followed in the design of the Taiwan network is that of the overlay of a high traffic digital network in the same time as maintaining the analog connection between the existing analog exchanges or between the analog sections of the digital terminal exchanges. The conversion of the network from entirely analog to entirely digital will take at least 15 years, and during this period analog exchanges will be operating jointly with digital terminal exchanges.

In the conversion of the Taipei network from totally analog to totally digital the plan has envisaged expansion of existing analog exchanges with digital units and replacement of obsolete electromechanical exchanges with digital units. The new digital sections will be loaded with the heavy traffic; subscribers with high traffic per line will be transfered from the analog to the digital section; the new digital exchanges will be connected with fiber optic or other digital media to other digital terminal exchanges.

The combination of the high traffic parallel digital network with the PCM ring is illustrated in figure 2. Analog exchange will continue to be interconnected among them only if traffic justifies a direct trunking, otherwise connections will pass through a digital tandem exchange.

The two criteria indicated above have been considered in the planning and optimization of the Taipei network.

INTEGRATION OF THE HIGH TRAFFIC NETWORK WITH THE PCM RING



THE ANALOG TO ANALOG CONNECTIONS ARE ELIMINATED.

figure 2

5. THE INTRODUCTION OF DIGITAL TERMINAL EXCHANGES IN THE GREAT TAIPEI AREA.

The planning department of the Northern Taiwan Telecommunication administration has planned the introduction of digital terminal exchanges as addition to the existing analog ones and for the replacement of the obsolete electromechanical exchanges. This plan covers a 20 year period and establishes;

- the size and in service date of each new digital unit.
- the expected working lines for each exchange in the years 1988,1993,1999
- location and size of every new exchange required in the network.

The diagram in figure 3 shows the percent of electronic and digital lines in each year 1984, 1988, 1993, 1999 and 2004.

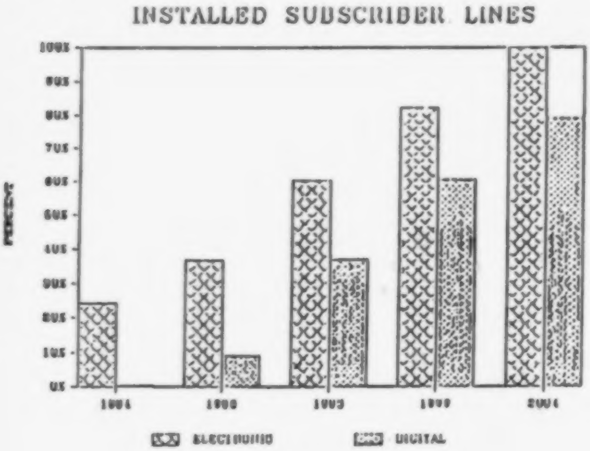


figure 3

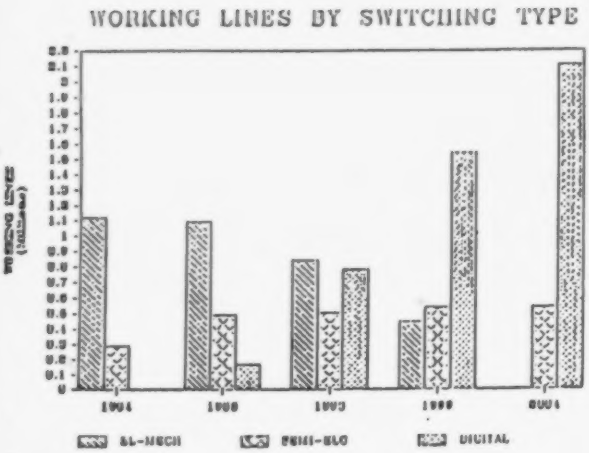


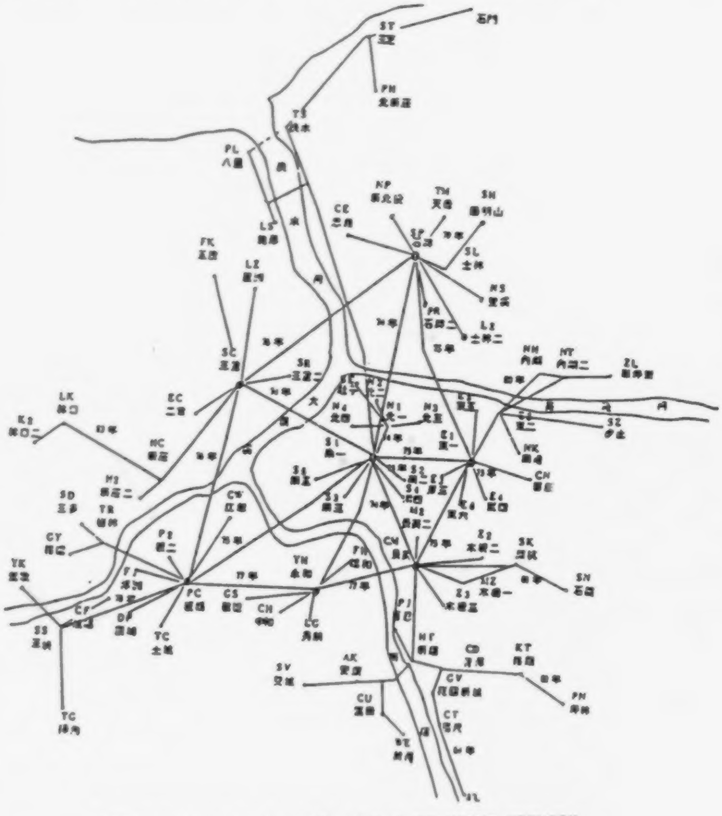
figure 4

The great Taipei area had 1,982,000 lines installed at the end of 1984, with 1,428,000 working subscriber lines. The plan considers that by the year 2004 the quantity of installed lines will be 3,125,000 in 85 exchanges and in 156 exchange units. Today there are 50 exchanges with 111 exchange units.

The diagram in figure 4 shows the working lines by switch type for each of the years above.

6. THE FIBER OPTIC PLAN

The planning department of the Northern Taiwan Telecommunication administration has planned the introduction of the fiber optic network connecting several exchanges in the city. The most important part of this network is to be in service by the year 1988. This network, which has been planned before the optimization study, has been designed to form a ring connecting with the center of the city the most important exchanges of the suburban area. A drawing showing the 1988 fiber optic network is shown in figure 5.



GREAT TAIPEI AREA ENTER OFFICE TRUNKING NETWORK

(OPTICAL FIBER) DIGITALIZATION PLAN

figure 5

7. THE INPUT DATA FOR AN OPTIMIZATION STUDY.

The most important data which is to be introduced in the calculation is an accurate matrix of traffic calculated today. The matrix has to consider all units and not only all exchanges. The definition of a "unit" is that part of the exchange that has a group of incoming or outgoing trunks that can be reached by every subscriber within the unit.

Exchange sites have often more then one unit. In Taipei most exchanges have two, three or more units.

The community of interest factor is a number which represents the probability that one subscriber of exchange A communicates with a subscriber of exchange B.

There are several procedure for the calculation of the "community of interest factors", but the most accurate is that which uses the matrix of traffic today to create the matrix of factors, using the formula which defines the community of interest factors:

The factor F AB is:

$$T\ AB = F\ AB \quad \frac{S\ A * S\ B}{TOTAL\ S}$$

In this formula

T AB is the traffic between the exchange A and the exchange B;
F AB is the community of interest factor between the two exchanges A and B;
S A is the quantity of subscribers homing on the exchange A
S B is the quantity of subscribers homing on the exchange B

TOTAL S is the total quantity of subscribers within the entire metropolitan area

The computer will calculate the matrix of community of interest factors from the input data for 1985. The size of the matrix of factors will be of the same size as the matrix of traffic. Consequently if we analize a network of 200 terminal exchanges we will have a matrix of community of interest factors with 40,000 numbers.

Even if not exact, there are reasons to believe that the matrix of community of interest factors does not change from one year to the next. The traffic will certainly change, but the community of interest factors change only for exceptional circumstances. However, those changes will not substantially influence the configuration of the network.

During a period of 15 years new exchanges will be created to replace others or to absorb part of an other exchange. In such cases, we have to assume that new exchanges will have the same community of interest factors as the old one.

For this purpose we have subdivided the territory of the great Taipei area in 50 geographical areas, and we have assumed that the factors will be the same for each geographical areas. The computer produces 50 set of factors that are extended to all present and future units in the same geographical areas.

8. CALCULATION OF THE MATRIX OF TRAFFIC FOR 1988, 1993, 1999.

The computer will calculate from the matrix of community of interest factors the matrixes of the estimated traffic for 1988, 1993, 1999. The input data contain the new values of subscribers for each year and for each exchange unit, and the total subscribers of the metropolitan area. In the case of Taipei the quantity of exchange units was 203 and the computer has produced one traffic matrix for each one of the three years considered and each one containing 40,296 point to point traffic values.

9. CRITERIA FOR TRAFFIC ROUTING.

Routing the traffic is important because it contributes to the efficiency of the network which is measured in erlangs per trunk circuit. Generally electromechanical networks are considered very good if their average traffic per trunk is close to 0.6 Erlang; digital networks are considered efficient if the average is close to 0.8 Erlang.

A good selection of traffic routing takes into account the fact that digital tandem exchanges are cost effective versus the analog ones.

Consequently the early introduction of digital tandem exchanges has a double impact in the investment: because of the 25 % increase in the efficiency of the network the quantity of trunks is considerably reduced for the same traffic; the reduced cost of a digital switched erlang versus an analog one and the full availability of the digital tandems reduce considerably the requirement of direct point to point groups of trunks.

The computer will establish depending on economic calculation three different categories of traffic routing between every two units:

- -Direct route. The direct route is selected any time the traffic between two units is 20 Erlangs or more. This figure corresponds to an efficiency close to 0.7.
- -High usage route. An high usage route is selected between any two exchange units if the traffic is below 20 erlangs but above 8 erlangs. However, if the distance between the two units is low and does not compensate the cost of switching an high usage route is selected also if the traffic is below 8 erlangs.
- -Tandem route. It the traffic between two units is below 8 erlangs and an high usage route is not justified the traffic will be routed always through a tandem exchange.
- -Overflow. In all the three cases indicated above the overflow traffic will be always routed via a tandem exchange.

The computer makes the selection of the type of trunks, but the routing selection must be introduced in the computer. We have to indicate which tandem exchange will be selected as the first choice and which one as the second choice.

In planning the network for the great Taipei area it has been decided that every exchange unit will be directly connected with an high usage route (called tandem) to all the tandem exchanges in the city. This decision has been taken for security reasons and also for an equal distribution of traffic.

The criteria for routing the traffic through tandem has been selected under the Y - X rule (see figure 6 below); when direct route between exchange units A and B is not economically justified, the first choice is to select the route to the distant tandem (the tandem close to the location of the incoming exchange); the second selection is to select the route to the nearest tandem (the tandem close to the location of the outgoing exchange) and from the tandem to the incoming exchange; as the third up to the seventh choice any other tandem can be selected. Overflow traffic will also flow through two tandems.

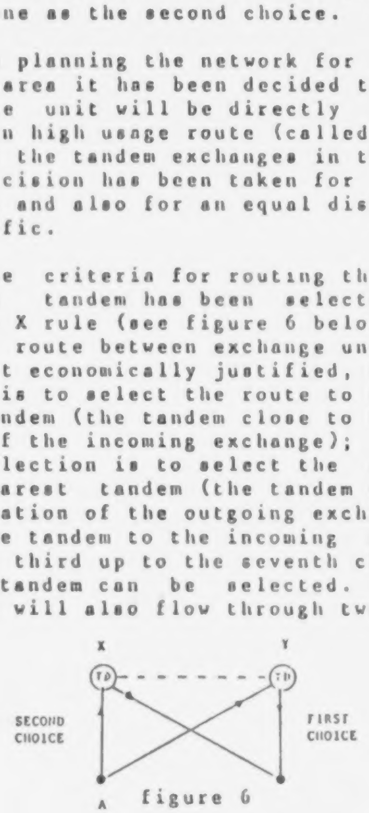


figure 6

10. THE DESIGN OF THE NETWORK

At this moment the computer cannot procede if we do not suggest all the possible alternatives for the design of the network. This is the work of the planner and the alternatives to be selected must be limited. Each alternative is represented by the indication of the possible tandem locations.

The alternatives are represented by the suggested number and location of the tandem exchanges. The first choice is represented by the number of subscribers and traffic homing to the tandems. In our study we have subdivided the great Taipei area in 10 tandem zones each one located in the areas of maximum concentration of subscribers. Consequently we have examined the traffic and subscribers homing to each area if the quantity of tandems was reduced to 9, 8, 7, 6, 5 and 3. The diagram figure 7 shows the 10 solution selected. The letters in the diagram represents the exchange code and the numbers indicate the total quantity of tandems.

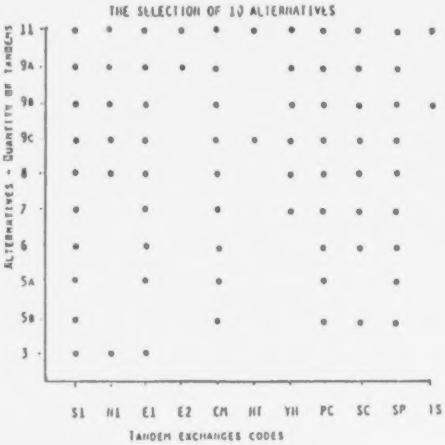


figure 7

11. THE DOCUMENTS PRODUCED BY THE COMPUTER PROGRAMS.

The computer elaborates the matrix of traffic for each alternative and for each year considered the quantity of trunks required:

- -for the traffic between local exchanges (direct routes).
- -for the traffic incoming and outgoing in each tandem exchange (to and from tandem to each local exchange).
- -for the traffic between tandem exchanges (tandem to tandem).

10 alternatives have been calculated; for each alternative the traffic of each

of the three years has been calculated. Consequently 30 volumes of data have been produced. Each volumes contains for each exchange-unit a list of trunk and traffic, and also the calculation of the annual charge of the trunks.

The calculation of the quantity of trunks is very complex and requires two different steps: the first is to add toghether in a single group to and from all tandem exchanges the traffic that are on the same route. The second step is to calculate from the traffic values the required quantity of trunks. For this calculation the program uses an algorithm that considers the type of switch, the quantity and type of trunks (Erlang B, Full availability/reversive formula with P=0.001 or Wilkinson tables).

Unit annual charge values have been introduced in the program for fiber optic systems, PCM system over existing cables, existing copper cables of different sizes, in order to calculate the annual charge values for each group of trunks. Also the requirement for analog to digital converters is evaluated when digital trunks are terminated in an analog exchange. The computer selects, in each case and for each quantity of trunks required, the most economic transmission media. Interconnection between tandems is considered via fiber optic cables.

In order to compare the results of each solutions three summaries are prepared by the computer:

- the trunking summary
- the matrix of trunks between tandem exchanges
- the calculation of all analog and digital trunks and percentage of the network which is digital.

An example of the trunking summary is reproduced here below.

12. THE BASIC PRINCIPLE FOR A LONG TERM NETWORK OPTIMIZATION STUDY.

The comparison for each year of the results of the trunking summary has permitted to exclude the solution with 3 and 5 tandems showing an annual charge considerably superior to the other alternatives. Because of the carefull selection of the alternatives considered, the values of the efficiency of the network were very close and of the corresponding annual charges figures were within a range of plus or minus 5 percent.

Other aspects have been taken into consideration:

- maximize digitalization at the earliest date;
- equally distribute the traffic among all tandems;
- not to exceed 20,000 switching erlangs for each tandem which corresp-

TRUNKING SUMMARY

	DIRECT TRUNKS	HIGH USAGE TRUNKS	LOCAL TO TANDEM TRUNKS	TANDEM TO LOCAL TRUNKS	TANDEM TO TANDEM TRUNKS	TOTAL TRUNKS
QUANTITY :	31321	28493	58603	68432	42505	229344
TRAFFIC : (E)	27075.	19025.	43949.	52433.	38438.	180710.
AVERAGE TRAFFIC : PER TRUNK	0.86	0.67	0.75	0.77	0.90	0.79
ANNUAL CHARGE : ($X1000)	3151.	2006.	6465.	8896.	1150.	21662.
AVERAGE AC/TRUNK : ($)	101.	70.	110.	130.	27.	94.
AVERAGE AC/ERLANG: ($)	116.	105.	148.	170.	30.	120.
TOTAL CKT.KS :	360297	159095	547954	836465	391582	2294052

onds to over 700,000 busy hour call attempts.

The figure 8 below shows the switched erlangs per each tandem. Because of too high concentration of traffic in a single exchange the solutions with 6 and 7 tandems have been eliminated and among the alternatives with 9 tandems that one indicated as 9A shows that the load of traffic over the tandems is very well distributed. For this reason the alternative 9A has been recommended.

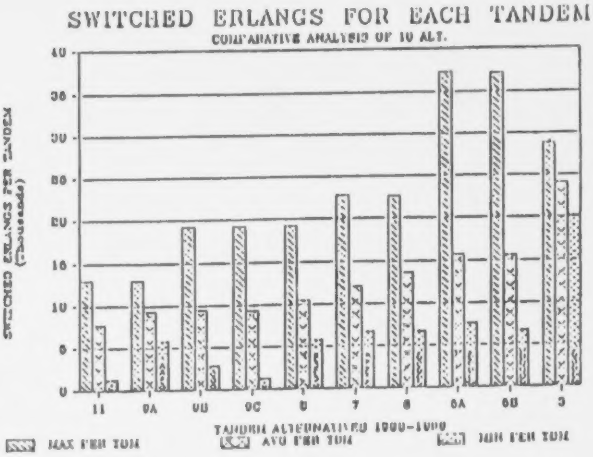


figure 8

Examining the results of the percent of digitalization in the year 1988 and 1993, and the diagram showing the switched erlangs for each solution the selection has been made.

As can be noticed from figure 9 below the traffic for some tandem will go down from 1988 to 1993, for others will go up. The total will increase very little, and this proves that the planning of tandems is a long term planning which does not change the configuration of the system but only the quantity of trunks.

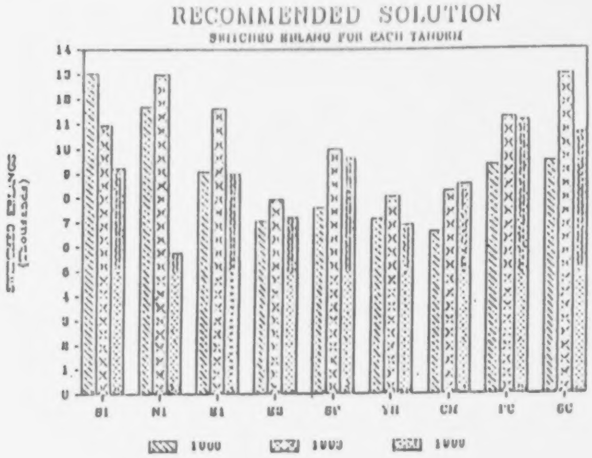


figure 9

13. THE RECOMMENDED SOLUTION.

The 9 tandem solution with location 3 in the center of Taipei and 6 forming a ring around the city, has shown to meet all above requirements.

The 9 tandem exchanges solution has several advantages and has a very limited investment for the analog to digital converters. The total traffic capacity of the network is closed to 180.000 erlangs in 1988, and increases up to 216.000 switched erlangs in 1993. Out of this amount the quantity of traffic switched by digital tandem exchanges is close to 100,000. The traffic load for each exhange is almost the same in the range of 10,000 switched erlangs. This quantity of traffic remains almost constant until 1999; new digital large terminal exchanges will be introduced and more direct trunks and high usage trunks will be required.

The figure 10 illustrates the PCM ring

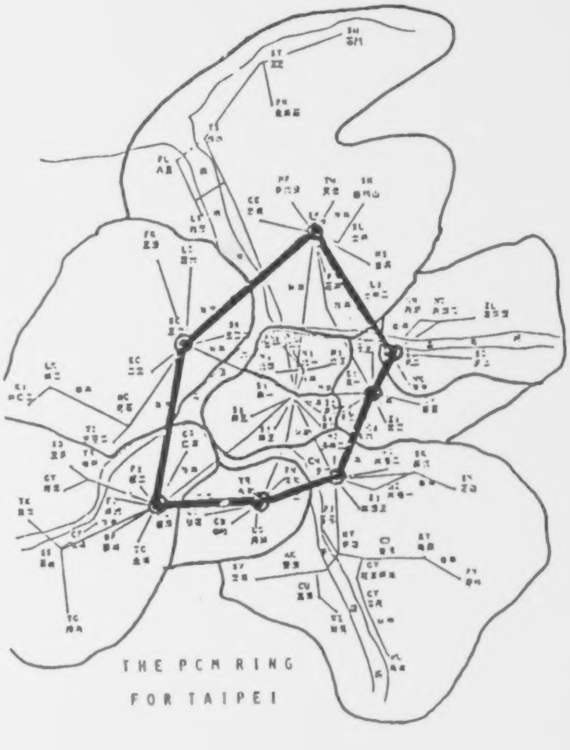


figure 10

in the city of Taipei. This ring is very important because every subscriber who is located outside the ring will have a conversation with an other subscriber located on the other side of the city, with the same quality of conversation as with a subscriber located in the same area, even during the period that his exchange remains electromechanical. This quality improvement of the service is rendered to the electromechanical subscriber starting from the moment a digital tandem exchange is installed.

In planning the network it has been decided that all terminal exchange must be connected to all tandems. In the relative cost comparison this recommandation penalizes the solutions with 9 tandems versus the alternatives with a lower quantity of tandems. This configuration has been selected for security reasons. Should this condition not being imposed, the economic advantage of the 9 tandem alternative would have been greater.

The selected solution has the advantage to equally distribute the digital network among all tandem exchanges. This fact, in case of failure of one tandem permits to all other exchanges to utilize all other tandem exchanges to flow the total traffic without any degradation.

The digitalization of the network is much more important then the digitalization of the subscribers; the investment in the digital transmission media and reduction of converters is a very important result. The figure 11 shows that the digitalization of the network is much higher then the digitalization of the exchanges from the beginning.

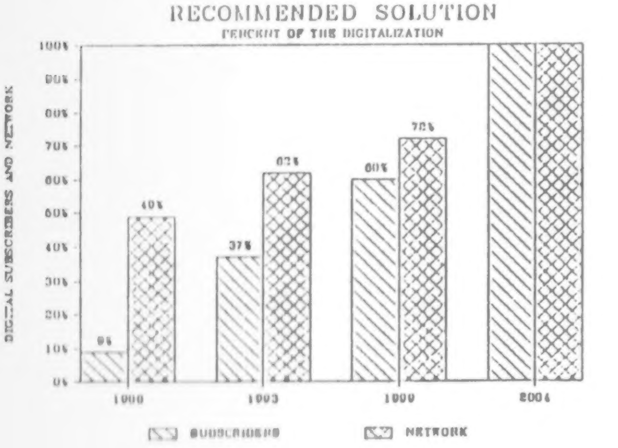


figure 11

This is the most important conclusion which allows to afirm the the tandem network configuration designed to day will not change in the 15 year period. The long term validity of this work is the basic goal that the planning department of the Northern Taiwan Telecommunication Administration.

14. THE EVALUATION OF THE INVESTMENT.

The final stage of the program is an evaluation of the investment required during the period 1985 through 1993 in order to transform the trunking network of the great Taipei area from analog to digital. This investment is formed by the new investment in new equipment and in reutilizatior of the existing cable plant.

The table here below shows the investment required over the long range period.

SELECTED 9 TANDEM SOLUTION
EVALUATION OF THE INVESTMENT

MAX. 1988-1993

	TOTAL 9 TANDEMS
TRAFFIC IN ERLANGS	96276.6
CALL ATTEMPTS ESTIMATED	3,466,678
UNITS	9
ANALOG TRUNKS 1988	87,429
ANALOG TRUNKS 1993	101,867
MAXIMUM ANALOG TRUNKS	101,867
DIGITAL TRUNKS 1988	143,109
DIGITAL TRUNKS 1993	97,455
MAXIMUM DIGITAL TRUNKS	143,109
MAXIMUM TRUNKS 1988	230,538
MAXIMUM TRUNKS 1993	199,322
MAXIMUM DIGITAL PORTS	234,618
DIGITAL SPANS DS1 1.5 MBIT.	9,780
DIGITAL SPANS FOR ANALOG TRUNK	4,250
TOTAL SPANS 1.5 MBIT FOR DIGITAL TRUNKS	5,967
DIGITAL SPANS DS3 45 MBIT.	217
FIBER OPTIC SPAN 90 MBIT	115
REPEATERS IN OFFICE PREMISES	45
SWITCHING	
GET STARTED	2,700,000
DIGITAL TRUNKS	130,602,120
PROCESSORS	17,333,388
POWER EQUIPMENT	720,000
DIGITAL MDF AND CROSS CONNECT	1,760,400
TOTAL TANDEM EXCHANGES	153,115,908
TRANSMISSION	
A/D CONVERTERS UNIT	17,612,810
MULTIPLEXER FOR 28 SPAN DS1	17,684,198
FIBER OPTIC TERMINALS	4,302,495
REPEATERS IN OFFICE PREMISES	1,781,550
FIBER OPTIC CABLES	3,603,600
TOTAL TRANSMISSION	44,984,653
OTHER	
SUPERVISORY EQUIPMENT	2,000,000
MISCELLANEA	20,010,056
TOTAL NEW INVESTMENT	220,110,617
EXISTING INVESTMENT TO BE UTILIZED	
OUTSIDE PLANT: END OFFICE TO TANDEM	30,352,995
TANDEM TO END OFFICE	46,177,065
END OFFICE TO END OFFICE	29,543,985
	106,074,045

AN OVERVIEW OF EXPERT SYSTEMS AND TELECOMMUNICATIONS APPLICATIONS

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ABSTRACT

First there were databases and database management systems. Then information bases developed, whereby management information systems and decision support systems sprouted. Now, there are knowledge bases on which expert systems are being built. The age of "knowledge" is upon us, and computer programs are being developed to preserve this knowledge. These computer programs are "expert systems" which mimic the behavior of human experts in some specified domain of knowledge. This paper addresses these expert systems and gives some applications in the telecommunications area.

"Expert systems" is an area which is gaining worldwide interest in industry, government, and academia. From telephone cable maintenance to medical diagnosis to tax planning, expert systems are being applied to an increasing number of applications. "Expert systems" is a subset of artificial intelligence and draws upon many disciplines, namely, cognitive psychology, linguistics, philosophy, and computer science. Although more research is needed to improve expert systems technology, expert systems are beginning to have a strong impact on assisting in the decision-making process.

This paper takes a look at expert systems and addresses their applications in telecommunications. First, the definition and background of expert systems are explained (Sections 1 and 2, respectively). Then the components of an expert system are discussed (Section 3), followed by how an expert system is built (Section 4). Then, some explanation, human factors, and uncertainty considerations in expert systems will be addressed (Section 5). Last, expert system applications in telecommunications will be explained (Section 6), followed by a discussion of advantages and limitations of expert systems (Section 7).

1.0 Definition

Throughout the literature, the name "expert system" is referred to as "knowledge-based expert systems," "expert problem-solvers," and "computer-based consultation systems," all having the same meaning. Unlike the many different names for an expert system, the definition of an expert system is fairly universal. An expert system is a computer program that emulates the behavior of human experts within a specific domain of knowledge.

Expert systems are particularly relevant for inferring and deducing from ill and unstructured constituents of problematic states of affairs. They constitute a structured methodology for conduct of analogical investigation. The major characteristics of an expert system include: (1) Able to perform at the level of an expert, (2) Represents domain-specific knowledge in the manner that the expert thinks, (3) Incorporates explanation processes and ways of handling uncertainty, and (4) Typically pertains to problems that can be symbolically represented. An expert system differs from a conventional computer program mainly by being more tolerant of errors and imperfect knowledge, and separating the expert knowledge from the general-reasoning mechanism. By having this partitioning of the "knowledge base" from the control structure, the knowledge base can be incrementally developed and the same general system can be used for different applications by "removing" the knowledge base and "inserting" another.

In the past, expert systems have worked well in problem areas with ill and unstructured aspects, as shown by the following characteristics:

- There existed at least one expert in the problem area who is generally acknowledged as such.
- The sources of the expert's expertise were judgment and experience.
- The expert was able and willing to explain his/her knowledge to a knowledge engineer.
- The problem was well-bounded to prevent an unmanageably large search space.
- The problem area had a real consensus, not, for example, like economics.

- Test data was easily available.

Now that an expert system had been defined and characterized, the next section will explain the background of expert systems.

2.0 Background of Expert Systems

The early work in expert systems began in the 1950's by the Rand-Carnegie team of Newell, Shaw, and Simon [1,2,3]. They developed the General Problem Solver (GPS) to solve problems of elementary logic, chess, and high school algebra word problems. Besides the Rand-Carnegie team, the MIT Group of Minsky and McCarthy were instrumental in the late 1950's and early 1960's in building a foundation for expert systems. McCarthy invented LISP programming language which is the dominant language used in artificial intelligence and expert systems. Also in the 1960's, an expert system called DENDRAL by Lederberg, Buchanan, and Feigenbaum started to be created which would infer a structure of molecules by mass spectography data. Other work on expert systems in the 1960's included SAINT (Slagle, 1961) for symbolic integration, STUDENT (Bobrow) for solving high school algebra word problems, and an expert system by Raphael for question-answering using trivial data bases.

In the 1970's, greater industrial interest in developing expert systems took place and continues through today. Expert systems are being developed in application areas such as diagnosis, perception, instruction, learning, game playing, programming, theorem proving, pattern and speech recognition.

Industrial interest, has been shown by Digital Equipment, Texas Instruments, Xerox, Schlumberger, Hewlett-Packard, General Motors, IBM, and others. Universities, such as Stanford, Carnegie-Mellon, Rutgers, University of Maryland, and MIT, continue to pursue expert system technology. Universities and private companies have been instrumental in developing other programming languages used in expert systems like Interlisp, MacLisp, IQLisp, Franz Lisp, Prolog, OPS5, PLANNER, and UNITS.

Next, a look at the components of an expert system and the building process of an expert system will be made.

3.0 Components of Expert Systems

An expert system consists of three major components: (1) dialog structure, (2) inference engine, and (3) knowledge base. The dialog structure serves as the language interface in which the user can access the expert system. Usually, the user interacts with the expert system via a consultative mode [4]. The inference engine is a program that allows an hypothesis to be generated based upon the information in the knowledge base. This is usually done by forward chaining, backward chaining, and forward and backward processing combined [5,6,7]. The knowledge base is the last and most important component of an expert system. The knowledge base is comprised of domain facts and rules of thumb based upon experience. Knowledge is represented by first-order predicate calculus, frames, semantic networks, scripts, or rules [8,9].

4.0 Building An Expert System

The time for construction of early expert systems was in the range of 20-50 man-years. Recently, simple expert systems can be built in 3 man-months, but a complex system is still apt to take as long as 10 man-years to complete. Using previously mentioned search space strategies and appropriate expert system application generators (these generators will be discussed in Section 4.1), development time is approaching 5 man-years per system.

The first step in building an expert system is to select the problem, define the expert system goal(s), and identify the sources of knowledge. The task must have a well-bounded domain of application to avoid combinatorial explosion. Additionally, there must be at least one willing expert for developing the expert system.

Once this step is accomplished, the next procedure is to acquire the knowledge from the expert in order to develop the knowledge base. It is also helpful to develop a framework for representing the acquired information. Knowledge acquisition is an iterative process in which many meetings with the expert are needed to gather all the relevant and necessary information for the knowledge base.

After the knowledge is acquired, the next step is to select a knowledge representation approach. These approaches include using predicate calculus, frames, semantic networks, or production rules, as described in the previous section. According to Software Architecture & Engineering, Inc. [10,11], rule-based deduction would be an appropriate method to use for knowledge representation if: (1) the underlying knowledge is already organized as rules; (2) the type of classification is predominantly categorical; and

(3) there is not a large amount of context-dependence. Frames or semantic networks are best used when the knowledge pre-exists as descriptions.

The next step deals with programming the knowledge by using a text editor in an expert system application generator or by using LISP, Prolog, or some other appropriate programming language. Then the last step can be achieved by validating, testing, and evaluating the expert system.

Validity assessment is necessary to validate the knowledge base and the expert system as a whole. Validity can be achieved by running the knowledge base on past problems. Validity can also be confirmed by other experts knowledgeable in the problem domain.

Testing is an important area to be examined because when the expert system finally runs, it typically produces a variety of unexpected results [12]. In order to correct these bugs, knowledge refinement and maintenance must be accomplished.

After knowledge refinement and maintenance are achieved, an evaluation of the expert system can be made by users currently working in the problem domain. This evaluation process is a post-audit to see if the expert system meets the objectives for why it was developed.

4.1 Expert System Application Generators

As previously mentioned, building an expert system from scratch could take up to 20 man-years. To decrease development time and associated costs, many expert systems are developed by using an expert system application generator. An expert system application generator contains a generalized dialog structure and inference engine. A knowledge base can be designed for a specific problem domain, and it would be linked to the expert system application generator to form a new expert system for a particular application.

There are many expert system application generators. Some of these are:

o ROSIE	Rand Corporation
o AGE	Stanford University
o HEARSAY III	U.S.C./Information Sciences Institute
o EMYCIN	Stanford University
o Keys	Weinstock/SRI
o RAINBOW	IBM
o KMS/KES and SPECTRUM	University of Maryland/Software Architecture & Engineering, Inc.
o YAPS	University of Maryland
o Expert Ease	Jeffrey Perrone & Associates/Human Edge
o ART	Inference Corporation
o GENIE/BATTLE	Navy Center for Applied Research in Artificial Intelligence
o M.1/S.1/T.1	Teknowledge Inc.
o TIMM	General Research Corporation
o INSIGHT/ INSIGHT 2	Level 5 Corporation
o KEE	Intellicorp
o PERSONAL CONSULTANT	Texas Instruments
o SRL+	Carnegie Group
o PLUME	Carnegie Group
o Reveal	Infotym
o PICON	LISP Machines Inc.
o DUCK	Smart Systems
o Rulemaster	Radian Corporation
o OPS 5/OPS 83	Carnegie-Mellon University
o Loops	Xerox PARC

5.0 Explanation, Uncertainty, and Human Factors Considerations

Ways of handling explanation, uncertainty, and ergonomics are important features to be incorporated into an expert system. Explanation capabilities are needed so that the user can question and challenge the results from the expert system as well as to understand how the results were achieved. In MYCIN, an expert system designed to diagnose bacterial infections in the blood, explanation can be arrived at as shown below, with the user asking the questions [13]:

```
(a)  **HOW DID YOU DECIDE THAT ORGANISM-1 MIGHT BE AN E. COLI?
        I used RULE021 to conclude that the identity of
       ORGANISM-1 is e. coli.  This gave a cumulative CF of
       (.47).
        Then I used RULE084 to conclude that the identity of
       ORGANISM-1 is e. coli.  This gave a cumulative CF of
       (.55).
        Finally, I used RULE003 to conclude that the identity
       of ORGANISM-1 is e. coli.  This gave a cumulative CF of
       (.74).
(b)  **DID YOU USE RULE163 TO FIND OUT ANYTHING ABOUT
       ORGANISM-1?
        RULE163 was tried in the context of ORGANISM-1 but it
       failed because it is not true that the patient has had
       a genito-urinary tract maniulative procedure (clause 3).
(c)  **DID RULE116 TELL YOU ANYTHING ABOUT INFECTION-1?
        No  RULE116 would be relevant to the primary-bacteremia
       when applied to ORGANISM-1.
        But clause 2 ("the gram stain of the organism is not
       known") was already known to be false for ORGANISM-1, so
       the rule was never tried.
(d)  **WHY DIDN'T YOU CONSIDER STREPTOCOCCUS AS A POSSIBILITY
       FOR ORGANISM-1?
        The following rule could have been used to determine
       that the identity of ORGANISM-1 was streptococcus:
       RULE033
        But clause 2 ("the morphology if the organism is
       coccus") was already known to be false for ORGANISM-1,
       so the rule was never tried.
```

Besides explanation capabilities, uncertainty and human factors should also be incorporated into the expert system. Even the expert is not sure 100 percent of the time; thus, an expert system should handle uncertainty. Several ways of handling uncertainty include: Bayesian statistics, belief functions (Dempster-Shafer Method and certainty factors), and fuzzy set theory. Human factors should also be designed into expert systems. Some possible features are the use of: messages, menus, free-text attachments, rules against undesirable input, and high-level English-like representation language for encoding the knowledge. With these considerations built into the design of the expert system, the success of the expert system will be greatly enhanced.

6.0 Applications of Expert Systems

Business and universities here and abroad are becoming increasingly active in the development of expert systems. Japan has launched a "Fifth Generation" computer project in April 1982 whose goal is to surpass the United States in expert system technology over a ten-year horizon. The expected budget is approximately $800 million in order to develop and implement ideas in knowledge-based engineering, problem solving and inference systems, intelligent interfaces, and logic processing machines.

In the United States, the government has been the principal source of funds for work in expert systems. The government agencies most actively involved are the Defense Advanced Research Projects Agency, National Institutes of Health, National Science Foundation, Office of Naval Research, National Library of Medicine, Air Force Offices of Scientific Research, U.S. Geological Survey, Navy Center for Applied Research in Artificial Intelligence, and the National Aeronautics and Space Administration.

Besides the government, universities and companies are showing an active interest in expert systems. Stanford, MIT, and Carnegie-Mellon are some of the leaders in expert systems development among the universities. The following companies are examples of those engaged in expert systems development: SRI, RAND, MITRE, AI&DS, AMOCO, BBN, Bell Labs, Computer Thought, DEC, Fairchild, GM, Hewlett-Packard, Hughes, IBM, Intellicorp, JAYCOR, Machine Intelligence Corp., Martin Marietta, Schlumberger, Smart Systems Technology, Systems Control Inc., Texas Instruments, Teknowledge, TRW, and Xerox.

Most of the existing expert systems fall under the functions of diagnosis, data analysis, analysis, planning, design, concept-formation, monitoring, knowledge acquisition, computer aided instruction, tutoring, management, automatic programming, or image understanding.

6.1 Expert System Applications in Telecommunications

Many expert systems have been developed in the diagnosis (e.g., MYCIN, PUFF, and CASNET) and equipment maintenance (e.g., IN-ATE and XCON) areas; however, only a few of these have been applied to the telecommunications field. The most notable expert system developed in telecommunications is ACE (Automated Cable Expertise). ACE was designed by AT&T Bell Laboratories and provides trouble-shooting and diagnostic reports for telephone company managers [14]. Its problem domain is telephone cable maintenance [14]. ACE serves as an assistant to the expert and its major function is an automatic analysis system which digests hundreds of telephone cable maintenance reports daily [15].

ACE was developed to perform cable analysis in identifying the need for replacement or rehabilitation of "outside plants." An outside plant is the collective term for the cables and other telephone equipment existing in the network between the subscriber and the local switch. Maintenance of the local plant is a vital and expensive operation for the local operating companies [14]. In order to restore poor service as quickly as possible, it often happens that telephone company technicians will repeatedly work around a problem without ever really solving it [14]. This means that the short-term problem is solved, but the long-term solution is typically not found. A data management and report generation system, called CRAS, maintains records on outside plant maintenance. However, there is a limited number of human experts who have the time and ability to analyze the CRAS data to identify areas for outside plant rehabilitation. Due to this scarce supply of human experts, ACE was designed to perform cable analysis in order to free the expert to pay attention to other demands.

ACE was originally implemented in Franz LISP and the OPS4 production system language, on a DEC VAX 11/780 running the UNIX operating system. It now runs on an AT&T 3B2 microcomputer and is located in the same offices as the cable analysts. ACE has four major components: a knowledge base, inference engine, interface to the CRAS database system, and a conclusion database. The knowledge base consists of four separate production systems (IF-THEN rules) plus an application program. The knowledge base is a set of facts and heuristics (rules of thumb) and was developed through the following sources [14]:

1. textbook knowledge developed from primers on telephone cable analysis;
2. expert advice from the developers of CRAS;
3. expert advice from theoreticians of cable analysis both in AT&T Bell Laboratories and in the local operating companies; and
4. local analysts from the operating companies and users of CRAS who perform the actual analyses.

The inference engine uses forward chaining (i.e., working from facts to conclusions) executing the MATCH problem-solving paradigm. The MATCH strategy breaks the task into a fixed sequence of noninteracting subproblems. This sequence is [14]:

1. a block of new data is requested from CRAS,
2. irrelevant data are filtered from the input,
3. the remaining data are assimilated with ACE's historical records on the outside plant,
4. checks are made to determine whether any conditions exist that should be subjected to detailed analysis,
5. requests for detailed CRAS data are made to explore possible outside plant problems,
6. alarming conditions are noted and diagnosed (is possible),
7. and finally, findings with supporting data and diagnosis are reported to users.

ACE uses different search methods in different subproblem stages [14]. For example, exhaustive search is used for searching the CRAS database [14].

ACE's menu-oriented interface allows users to use an English-like query facility to make "high-level" requests [14]. ACE omits, however, some characteristics that are typically considered to be part of an expert system. One such characteristic is the use of explanations. ACE does not provide a full English-like explanation of ACE's output. Instead, ACE provides a description of the data supporting whatever trouble diagnosis has been reported [14]. ACE also does not handle uncertainty. Most expert systems will have ways of handling uncertainty like Bayesian statistics, certainty factors, or fuzzy logic.

ACE's last major component is the conclusion database. This is where ACE stores results that can be accessed by users at any time. This is helpful so that users can review conclusions and recommendations made by ACE on previous days [14].

ACE is one of the few "expert systems" that has been successfully used commercially. It has been tested continually since the spring of 1982, and local analysts have been very satisfied with its performance [15].

Besides ACE, there are very few other expert systems developed for telecommunications. TRACKER was developed by British Telecom for fault diagnosis of electronic PABX power supplies. Lockheed has designed an expert system for diagnosing faults in switching networks. NASA's Johnson Space Center is developing expert systems to perform on-orbit position determination for the space shuttle and space station, and to do processing of radar tracking data during shuttle ascent and reentry. ANALYST, by Mitre Corporation, is used for processing sensor returns. HASP, and its follow-on, SIAP, were developed by Stanford University for the interpretation or understanding of signal data. ANALYST, HASP, and SIAP are remotely related to telecommunications as they involve the interpretation of sensors.

In the next section, some future areas for expert system development in telecommunications will be cited.

6.1.1 Future Expert System Applications in Telecommunications

In the next few years, expert systems will start spreading in the telecommunications field. Their infiltration will probably take place in the following areas:

- spectrum management
- satellite trouble diagnosis
- equipment maintenance
- tracking/navigation of satellites
- information management
- selection and configuration of local area networks
- sensor/signal interpretation
- scheduling of tele- and videoconferences

These are a few of the fruitful areas in which expert systems technology could be applied.

In the last section, the advantages and limitations of expert systems will be explained.

7.0 Advantages and Limitations of Expert Systems

Expert systems offer new ways to encode and employ knowledge to solve problems [1]. They are improved approaches to formalizing and handling knowledge previously thought unsuited for formal organization [1]. Expert system applications have shown that programs can operate at or near the level of human experts. This is particularly advantageous in cases where one needs expert advice, but is unable to get a human expert due to high costs, unavailability of human experts, and time constraints. An expert system can be used to support and verify a human expert's opinion, and it can be used in situations in which an individual may become easily flustered due to time and pressure constraints.

As there are advantages of using expert systems, there are also limitations. First, the knowledge acquisition process (i.e., the learning process) is a major limitation of expert systems. Although the computer programs are fairly adept at making analyses, most cannot learn from experience. Second, there is a potential problem in the manner in which generality and specificity are simultaneously being achieved [2,16]. This leads to the difficulty of combinatorial explosion of search-spaces, which is presently being handled by enabling the solver to operate within a narrow, specified context. Third, there is a difficulty in debugging programs containing large amounts of knowledge. Fourth, the expert system should be able to automate the input from various experts and integrate it, instead of having one expert acting as the sole source of knowledge. Fifth and last, because this field is relatively new, there is a shortage of knowledge engineers who are responsible for acquiring, representing, and programming expert knowledge.

If the limitations are addressed and resolved, then expert systems will become powerful and useful tools for many applications, particularly in telecommunications.

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CHIP CARDS (MEMOCARDS) AND TELECOMMUNICATIONS

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1. ABSTRACT

The Chip card, also known as the Smart Card, Memocard, and Memory Card, is the true portable intelligence and memory. It is the complete distributed intelligence and portable transaction system. Through its packaging which is usually the size and shape of a standard credit card it can be easily accomodated by voice, data and video terminals for numerous applications. The applications range from using the card as a portable address, telephone and appointment book when used with a compatible voice terminal, to a pay as you view T.V. card which can unscramble the signals through a terminal unit and have the user's account debited within the card. In all instances, the card is an extension of a network and is the true pocket-sized personal computer and/or memory.

2. INTRODUCTION

2.1 DEFINITIONS The chip card also known as the "Smart Card",

"Memocard" and "Memory Card" is based upon the following definitions: (1)

SMART CARD AND MEMOCARD - consists of one or more silicon integrated circuits encapsulated within plastics and similar in size and shape to a standard credit card, but not limited to the credit card specification. It is a portable data carrier which contains on board intelligence in the form of a microprocessor and on board non-volatile electronic data storage (Memory).

MEMORY CARD - consists of on board non-volatile memory only, usually in larger amounts than that of the Smart card and Memocard. It does not have on board intelligence. It is a portable data carrier only, designed for human handling including, but not limited to, the size and shape of a credit card.

NON-VOLATILE ELECTRONIC DATA STORAGE (MEMORY) - a non-volatile electronic memory is one which no on board power source or continuous power is required from an outside source in order to retain its contents. The following are non-volatile semiconductor memories:

ROM -	Read Only Memory
PROM -	Programmable Read Only Memory
EPROM -	Electronically Programmable Read Only Memory
EEPROM -	Electronically Erasable Programmable Read Only Memory

The cards known as Smart Cards and used primarily in financial systems tests are mainly based upon EPROM; in that once data is put into the memory it cannot be replaced and if data is to be updated it must be placed in the unused part of memory. Once the memory is filled the card is usually obsolete and must be replaced.

The card known as Memocard or in some cases the "Genius Card" uses EEPROM. The EEPROM allows the card to maintain its data integrity for at least 10 years, in that memory can be electronically erased, replaced, and information moved from one part of storage to another. In fact, the memory is equal to Random Access Memory found in standard computers with the exception that memory is not lost when there is no power.

NON-VOLATILE DATA STORAGE (MEMORY) - No power source is required in order for the memory to retain its contents. The following are other than non-volatile electronic memory:

MAGNETIC STORAGE - this is the application of a magnetically recordable medium to a surface which is most commonly a plastic credit card. The direction of magnetization along the strip defines the existence of binary data, and, hence, the storage of information. Data is easily readable and erasable, and the conventional magnetic striped bank card has a storage capacity of approximately 1700 bits of information. Higher data capacity magnetic stripes exists for other application areas, and approach 20,000 to 30,000 bits of information.

HOLOGRAPHIC STORAGE - similar to magnetic stripe, the holographic data storage principle imprints a holographic pattern on the card. A light source in the reader detects refracted light from the pattern. The technique has a very low storage density (approximately several hundred bits).

OPTICAL STORAGE - optical data storage uses a reflective substrate as the mechanism for storing digital information. A low power laser is used to burn microscopic holes into the surface of the reflective stripe, indicating the status of a digital bit of information. This technology has the ability to acheive very high data capacities, with a small strip capable of storing 1 million bits of information.

SMART CARD AND MEMOCARD INTELLIGENCE

The intelligence is an on board microprocessor also known as a micro computer unit (MCU). The MCU can be combined with memory in a single chip as is the case with most Smart Cards which combines an 8 bit processor with 8K bits of EPROM; or the processor can communicate by a bus to a memory chip such as is done with the Memocard which uses an 8 bit processor to communicate with up to 64 K bits of EEPROM. In addition, each MCU has its own memory in the form of PROM.

2.2 HISTORY

The Smart Card was given its impetus by the French Government about 8 years ago; however, an original patent concerning chip cards was filed by IBM in the U.S.A. in 1972. The French Government thrust was in part due to the famous "Nora Minc Report" of 1978 to the President Giscaird D'Esating concerning a high technology plan for France for research, development and manufacturing in the area of Telematique or what was then known as computer and communications or the information industry. For example, the French Packet Switch and Videotex development was a direct result of this effort. Literally billions of francs have been spent to create a French Hi Tech International Information Industry. The French Government used as its vehicle the government owned Telecommunications company (PTT) and its suppliers. The French Smart Card was another output from the research and development efforts in Telematique. The companies in France implementing the technology are CII Honeywell Bull, Schlumberger, and Phillips. The French Smart Cards are patented. The second major country implementing chip card technology is Japan and the company that appears to be leading is Casio.

The Memocard however was developed and manufactured in Switzerland and is the first commercially available chip card that has an 8 bit processor and EEPROM. It is the first reusable chip card. Initially, the Swiss chip card was developed by entrepreneurs specifically for the Telecommunications Industry whereas the French and Japanese Smart Cards are primarily geared toward the financial community. The first commercially available Swiss product was announced at "Telecom 83" in Geneva, which is the major telecommunications conference and exhibition sponsored every 4 years by the International Telecommunications Union. The Swiss chip card was announced and made available together with fully featured telephones, that in fact have unlimited memory and intelligence when the card or a sequence of cards are placed in the telephone's card receptacle. The Swiss chip card products are also patented.

The ultimate in a pure memory card is the optical storage card based on laser technology which was developed and patented by U.S. entrepreneurs. The leading company is the Drexler Technology Corp. The card is pure memory and can store up to 16 million bits of pre- recorded data. The current card stores 1 million bits of data. The initial availability of the card with a compatible terminal is scheduled for its first commercial test, Nov. 1985 as a medical/ history card known as the Lifecard by Blue Cross and Blue Shield of the state of Maryland. The read/write units which attach to a Personal computer will be produced in Japan.

In summary, the 3 major types of cards that are available today that have been either commercially available with terminals - as is the Memocard - or scheduled to be available with terminals for test - as is the Optical Storage Card, are the French and Japanese Smart cards using an 8 bit processor and EPROM, the Swiss/ American Memocard using an 8 bit processor and EEPROM; and the Optical Storage card with pure memory. The next section of this paper will address the current state of the art technology used in chip cards.

3. CHIP CARD TECHNOLOGY

3.1 PHYSICAL PACKAGING - There are 3 major types of pyhsical packaging; one is where the memory or part of the chip is exposed, another is where the single chip which includes the processor and memory is plugged and epoxied into the card surface, and the third in which the processor and memory chips are completely encapsulated within the card. There are other pyhsical requirements for ruggedized cards or equivalent packaging such as in the shape of a key or a soldier dog tag; for such requirements the chips are encapsulated within the package.

The most common physical package is the size and shape of a standard plastic credit card. In order to obtain the credit card size either the single chip epoxied wirebonded solution of the French Smart card is used or the Tape Automated Bonding techniques of the Swiss Memocard is used which encapsulate the chips completely within the plastics.

The different bonding techniques used for bonding the micro- processor and/or memory chips define whether or not the chips can be encapsulated, the physical size of the card, and if more than one chip can be encapsulated. Miniturization and bonding of the chips are key to the cards success and physical endurance. The other key is the encapsulation material, be it plastic or fiber glass.

At this time the key chip mounting techniques for small packages such as watches and calculators are:(2)

surface mounting: a method for soldering packages directly on to the surface of printed circuit boards without insertion of the leads through holes in the board.

tape - automated bonding (TAB): a method of bonding unpackaged chips directly to a printed circuit board or into a package by means of a sprocketed tape, resembling photographic film, that holds the leads

It is predicted that TAB will predominate in the future, since TAB eliminates leads altogether by the chips being attached to sprocketed reels of plastic tape, which are then laid down on to a substrate for support.

The Swiss were the first to invent chip wire surface mounting techniques in the late 1960s as a way to decrease the volume of electronics in watches. As a matter of fact, one of the simplest mounting techniques is called the Swiss Outline. TAB was invented in the United States. However, improved techniques have been developed in Switzerland for the same reasons that they invented the first wire surface mounting techniques. The key countries involved in TAB are the U.S., Switzerland and Japan. At this time the Japanese are using TAB for their smart card to be delivered in 85, and the Swiss are using wire surface mounting for their currently available Memocard, and TAB for the Memocard to be delivered in Oct. 85.

Miniaturization is another requirement, in particular in Non-Volatile Electronic Memories. At this time, the French and Japanese Smart cards have only 1K bytes of EPROM for use; this is due to the French 1 chip technology of packaging both microprocessor and memory in 1 chip. The Swiss-American Memocard has 2 K bytes of EEPROM commercially available due to the capability of embedding 2 or more chips in the card. The Swiss will be delivering 8K byte EEPROM cards Fourth Quarter 1985. It is predicted that at the end of 1985 the U.S. EEPROM manufacturers will have in test, ready for delivery in 1986, 256 K bit or 32K byte chips. It is also a well known fact that EPROM is available in large bit capacity and is coming down in price.

The Non-Volatile memory card using magnetic strips, holograms, and optic technique are all surface mounted and more exposed. The French Smart Card has the integrated processor and memory chip mounted under the contacts which are exposed on the surface of the card. In all these cases there is potential for damage to the memory and/or processor. Chips that are Tape automated bonded and encapsulated within the plastics are more reliable than those that have been exposed, or those chips that have been wire mounted.

For those of you who have credit cards with magnetic stripes, you may have received a notice along with your card, as I did with my Visa card, that states:

"Care for Your Card: cards with magnetic stripes should not be stored back to back. This will destroy the information encoded on the stripe. If possible, carry cards completely separated." "Carry cards in a manner which minimizes their chances of becoming bent or warped. Almost anything is better than a hip-pocket wallet."

As you can see even the standard plastic mag. stripe card designed for an average life of one year has reliability problems. Smart cards are designed for an average life of 3 years and Memocards to at least 10 years or longer.

Other physical packaging of the card includes such things as customer art work, printing, embossing, combining chip cards and magnetic stripes, signature pad, photo, watermark, hologram and design patterns all of which are to make the card easy to identify and non-conterfitable. The location of the contacts and the optical memory for example impact the location of the required artwork and printing.

There is a need to meet the standard requirements of various industries for artwork, magnetic stripe, embossing and the like. For example the Banking Industry requires certain physical attributes including the standard location of a magnetic strip on the chip card.

The U.S. telecomunications industry requires conformance to their present charge cards. The French and Japanese Smart Cards and the Optical Memory Card allows for customer art work and the magnetic strip. The Swiss American Memocard allows for the addition of a Guilloche which is a special print as used in Swiss currency and is very difficult to counterfeit, as well as an embedded watermark within the plastics.

The packaging of the chips and the type of material used must match specific end user requirements, in particular, if it is to be used by the general public, athletes, military and hospitals. The device should have the capability to withstand stress, bending, heat, cold, and general wear.

3.2 PROCESSORS - the Smart cards and Memocards of today all use 8 bit processors. Just to give you a comparison - a powerful computer in the early 60s was the IBM 1401 which had an 8 bit processor and up to 8K bytes of magnetic core memory in which we programmed many major applications - and if sold, would have cost $300,000.00. In the mid to late 1960s the IBM 360 was announced and part of that announcement was the 8K byte model 20 central processing unit which was still a main frame with an 8 bit processor. We could program teleprocessing applications on the model 20. In the 70s Digital Equipment and Data General introduced the Mini computer which lead to distributed processing. The early minis had 8K bytes as well. In the early 80s the personal computer became prevalent. Apple established this new era with an 8 bit processor and a variety of memory sizes, however, the first Apple was 8K bytes. A chip card with an 8 bit processor and 8K bytes of EEPROM is equal to all the mainframes just described. In addition, the chip card mainframe does not lose its Random Access Memory in the form of EEPROM when power is off as do all mainframes, minis, and PCs.

The chip card mainframe as is provided by the Swiss/American card for example can give a user all the capability that has been provided by previous Central Processing Units, all that is required to make the configuration complete is input and output units, a power source, and if required, some auxiliary storage. The chip cards require low power and therefore a terminal with a keyboard, display, some memory, and power can supply all that is needed to the chip and the mainframe.

The micro processors used are based on standard available 8 bit processors designed to meet the requirements of the chip card manufacturer with a proprietary mask. Therefore, the resulting chip is proprietary, since the masks are protected by the "Semiconductor Chip Protection Act" of the United States. Those masks allow the chip cards to have unique micro processing characteristics to match the requirements for specific uses of the card, in particular, for security and to protect against reverse engineering.

Future chip cards will contain 16 bit and if required, 32 bit processors. With the advent of Superchips (3) which can contain 4 million transistors and are predicted to be available by the end of the 80s, together with the increase of EEPROM memory on a chip, and the replacement of silicon with gallium arsenide, the chip card is the basis for a very powerful portable mainframe. With gallium arsenide production problems now solved, it enables the following advantages over silicon: (4)

- moves electrons at least 3 times faster than silicon
- emits light
- absorbs sunlight more effectively.

and electronic data on a single chip.

It is possible to conceive of not only a portable main frame but a portable system with its I/O and power.

3.3 MEMORY - The memory on chip cards excluding the memory cards that use magnetic, holographic and optical storage, are of 2 types - EPROM and EEPROM. The EPROM is not reusable. Once data is placed in a location it cannot be changed. The Smart card updates its memory by placing new information in an unused part of its memory and recognizing that that address in memory has the latest information. Once the EPROM memory is completely used, in most cases the card must be replaced.

The EEPROM is a memory that can be updated and be used as if it is Random Access Memory. Information can be replaced, changed, moved, and erased. In addition, it could contain application programs and tables in the same fashion as magnetic disks. The technology can also allow for on board processing by application programs in the EEPROM interacting with the microprocessor in the card. The EEPROM chip card can interact in an optimum fashion with computers and intelligent terminals.

3.4. CONTACTS AND I/O PROTOCOL - The present standards thrust, in particular, in the International Standards Organization (ISO) for financial chip cards is to standardize on the Japanese and American proposal which is to have 8 contacts (2 columns and 4 rows) at the center left of the card front or back. The French proposal is to have the same array of 8 contacts but only in the upper left. At this time it is expected that the financial community will accept the ISO recommendation and that the French and their supporters will continue with their standard as a subset since in fact they have implemented their card and have set up major manufacturing facilities to produce to their standard.

The Swiss-American card, the Memorycard, has 9 gold edge connectors and was designed for immediate use for telecommunications and to be used with specific terminals. The edge connectors are supported by a number of industries other than Finance and include Security, Telecommunications and Transportation.

The difference in connectors also dictates the protocol and the card terminal receptacle. The 9 edge contact configuration transfers data with its protocol faster than the 8 contact configuration which at this time only utilizes 6 of the 8 contacts. In addition, the edge contact configuration allows for a less expensive and more reliable receptacle.

In the future there could be the development of contactless cards with a variety of means to read/write and instruct the card without physical contact.

It is important to note that standards should not limit the development of new technologies and applications, and that technological tests and comparisons should be made before standards are accepted. In all cases however once a standard is established it then dictates to the manufacturers of the chip cards and terminals what are the basic design specifications. It can be expected that all serious manufacturers will conform to the standards.

At this time protocol between the card and the read/write or terminal device is under discussion in the standards community. Therefore there are different protocols between the available chip cards. In all cases however the transmission of data is serial. It is conceivable parallel transmissions may be a future requirement.

An overall comparison of chip and memory cards is shown in Figure 1 summarizing the points made in this section. It also shows the capabilities of the cards to provide card access security, data encryption and user programmability.

3.5 ELECTRONIC SECURITY - The Smart cards and Memorycard provide for what is known as a watchdog or 'security officer' function (5). This is the function that makes sure that a transaction is valid. With both the Smart card and the Memorycard, if the card is stolen and the person tries to initiate a transaction using an improper access code or Personal Identification Number (PIN), and tries it a number of times defined to the card "security officer", the "security officer" will permanently close access to the card making it useless. At this time the French Smart card allows for a pre-determined PIN and will be locked by

COMPARISON OF CHIP & MEMORY CARDS

FEATURES	MULTIMIL's MEMOCARD	OPTICAL MEMORY CARDS	SMART CARDS
Common Name:	Memocard^R- Swiss/American	Laser Card^R	Casio Card/French Card
Technology:	Multi-chip	Data storage only	Single chip/ Two chip
Processor Type:	8 bit proprietary	None	8 bit proprietary
Memory Type/ Capacity:	ROM EEPROM 2K bytes or 8K bytes	Optical Laser Process 2M bytes	ROM: 1.6K bytes RAM: 36 bytes EPROM:8K/1K bytes
Contact Types/ Position:	Edge Connector or ISO standard	N/A	Circle - upper left front or 8 small squares center of Card
Reusable - can re-write to same area:	YES	NO	NO
Card access Security:	User choice of PIN & No. of tries before locking	Limited to manufacturer's specifications	Pre-defined User PIN. 3 tries only
Data encryption:	YES - programmable	NO	YES
User Programmable:	YES	NO	YES

FIGURE 1

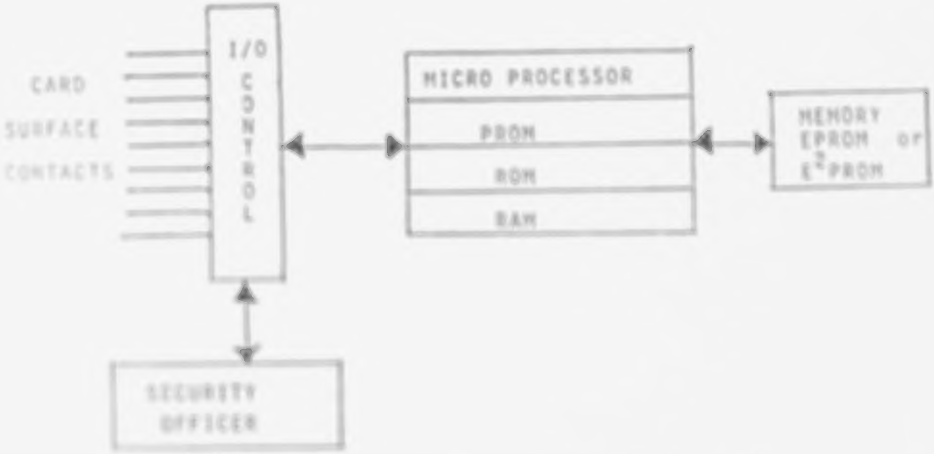
CARD
SURFACE
CONTACTS
I/O
CONTROL
MICRO PROCESSOR
PROM
ROM
RAM
MEMORY
EPROM or
E^{2}PROM
SECURITY
OFFICER

FIGURE 2 CHIP CARD ARCHITECTURE

the "security officer" function after 3 tries. The Swiss/ American Memocard allows for a user determined PIN which can be changed at any time and allows for any number of re-tries from one to above 100 if necessary. Also the personal access code can go up to 14 characters. Chip cards allow for an authentication code word and issuer code word both of which are inaccessible from outside the card.(6) The issuers code word is the only code that can unlock the card and this is normally done through a special terminal at the issuer's location. The PIN is the identification of the bearer of the card and the Authentication code established by the issuer is used for the authentication of transactions involving the card. Figure 2 shows the architecture of a chip card with a microprocessor and memory.

4. TELECOMMUNICATIONS APPLICATIONS

Telcommunications applications for the chip cards include voice, data, videotex, and pay TV. This section will describe the applications with reference to actual working examples where they exist.

4.1 VOICE - the applications with which the chip card is being used today is for pay telephones and for extending the capabilities of feature phones and auto dialers. The French PTT has tested the smart card with pay telephones and is in the process of installing pay phones to utilize the pay telephone card as a debit card. The card is loaded with a pre-determined amount the user can spend on calls and is debited as calls are made through the card pay telephone; once the card is completely debited and the memory used, the card must be replaced.

The Swiss/American company, Multimil Inc., offers a fully reusable Memocard with a line of integrated data storage/voice terminals. The card is the bearer's telephone and address book, real time appointment calendar, telephone company credit card, such as ATT GTE or the Bell Operating Companies and other common carrier access numbers, such as MCI and Sprint with user identification. The card also is instructed to know its bearer's geographical location by country code and area code. The card is completely reusable and therefore numbers, names, information, and even application can be changed. The card when placed in a compatible terminal identifies itself through its geographic code, the terminal in turn identifies its geographical code. Together the micro in the card and the micro in the terminal make the appropriate modifications which cause the terminal to become the card bearer's terminal by adding and deleting the appropriate country and area codes to the numbers dialed from the card. The card itself can hold up to 1000 telephone numbers. This gives the terminals unlimited speed dialing capability and a productivity tool for travelers with the geographical identification capability. The card holder uses the same code or name to dial from any compatible terminal at any location in the world.

The Memocard allows the system consisting of the terminal and card to chain a telephone credit card number or an other common carrier (OCC) access code all of which are located in the card, to any number in the terminal or card. This is particularly important as a productivity tool in the U.S. since to dial these types of numbers manually would require 28 to 32 digits, and if a mistake is made or one encounters a busy signal, the 28 digits must be redialed. The card dials these numbers with only 3 keystrokes even when using credit card or OCC access code functions.

The credit card feature also allows the bearer to use someone else's compatible terminal as his own, but yet charge the calls to his own credit card automatically and not to the owner of the telephone. The other common carrier codes feature allows the bearer of the card to chose the most economical carrier for specific calls or the carrier with the highest quality system for specific calls. The feature capabilities just described will become even more useful as equal access is implemented in the U.S.

4.2 DATA - The applications for data transmission appear to be primarily in Value Added Networks such as those offerings provided by Telenet, GE Information Systems, ATTIS, and IBM. Although there are no examples to date, one can easily identify certain areas where the chip card can be applied. One area is similar to those functions described in voice application of the Memocard. The card can be used to dial data bases, telex/twx terminals and computers with specific applications within the user's network and take advantage of the speed dial, geographic I.D., credit card and OCC numbers. In addition, the card can contain authorization codes for access to specific databases and allow only those with a need to know to access computer applications and information banks. The chip card can also be a security key and have the capability to lock/unlock a data terminal as it does with voice terminals.

4.3. VIDEOTEX - The supporters of the Videotex systems believe that chip cards are the answer to the future success of such systems. The following is a quote from a paper given at Videotex 84 International held in Amsterdam, November 1984 (7) "Prospects for videotex in general and for business videotex applications in particular are still highly controversial. Many individuals and organizations still do not believe that videotex will be a viable business. They don't believe consumers are willing to pay $20 per month for information that is available in print for much fewer dollars per month. They are probably right, that may be too much to pay for information retrieval. But, information retrieval will not be the instrument which sells videotex.Transactional services will sell videotex. An important question is whether videotex services can be used for transactions like elctronic banking at home, shopping at home for local and national thatre, etc. But for videotex to take full advantage of these possibilities, there must be a means for guaranteeing the security of transactions and providing both individuals and businesses with adequate records of these transactions. "Tomorrow's electronic debit and credit cards can provide these means. They will be compact enough to fit in a wallet, yet, will have enough memory and processing power to hold records of transactions and perform security checks on the validity of these transactions." A small and controlled Smart card test with Videotex was implemented by J.C. Penney, a large U.S. retailer based upon a videotex sytem they acquired from a North Dakota bank (First Bank Systems Inc.) which applied a videotex service to approximately 300 farmers. (8) In the test the card was programmed for a PIN, encryption capability and the recording of completed transaction information. As as result the farmer was provided with a portable ease of use method for coducting his financial business and transactions securely and confidentiall and keeping his records in his personal possession. The test was limited to 10 terminals and therefore it is recommended that an expanded and longer test be implemented to prove thatchip cards in fact are the answer to videtex.

4.4 PAY TELEVISION - in particular those that are reuseable can bring to fruition the pay per viewing television service. The Paytel Ltd. of England together with the Swiss Multimil Memocard is offering such a capability. In the cable or direct broadcast T.V. System the signals are scrambled by an encoder at the transmit end. At the receiving end the picture is unscrambled by a decoder to the subscriber. Since the scrambling sequence is different for each program, the decoder must be provided with the necessary unscrambling code for the individual programs. This information is obtained through a Memocard supplied to the subscriber which has previously been programmed by a computer.

The Memocard enables the subscriber to view any program for a specified time without payment. The decoder is connected such that the subscriber can view any program by simply pressing the button that unscrambles the picture. This system enables the offering of a large number of programs and allows each subscriber to select and pay for individual programs.

The unscrambling code for each program is contained in the memory of the Memocard. The card provides the decoder with the necessary code to unscramble the program. The card also records the I.D. number of the decoder and the I.D. number of each program that is unscrambled. When using more than one channel the card also records the channel number. As a safety feature once the card has been used in a decoder, it cannot be used in any other decoder with a different I.D. In addition it can lock the decoder.

The card records television usage and by the information on the card, invoices are prepared by reading the information on the card in commmunication with a computer System. This can either be done through a telephone with a card receptacle and modem, or by mail to the computer center. If the subscriber fails to make payment the card is not updated. In the mail situation two cards are required for one subscriber. In summary it is expected that Telecommunications will be the first to use chip cards commercially in fact the memocard and its voice terminals are the first commercially available chip card telephones in the U.S. and Europe.

5. OTHER CHIP CARD APPLICATIONS

In this section a brief summary will be given on other applications of the chip card covering medical, financial and security.

5.1 MEDICAL - The Optical storage card, the Smart card and the Memocard are applicable to the Medical sector each geared towards specific applications. The optical Storage card is being tested by Blue Cross and Blue Shield of Maryland as a Life Card and will contain 800 pages of data, including digitized photographs, X-rays, and CAT scans. Initially a summarized medical history and patients signature and/or photo will be entered into the card, then everytime a patient visits a Maryland hospital, physician or pharmacist additional information will be added. With this technology information cannot be erased or destroyed.

The Smart card which is intelligent but not reusable can be used as a limited personal medical record card, in particular in terms of an I.D. card of eligibility for Medical Insurance and in having permanent record information.

The reusable chip card such as the Memocard can be used for dynamic medical records and sports medicine records since information can be changed, moved and erased. The card can be used as a personal record card with I.D. numbers and authorization code allowing people with different responsibilities to view and update specific information. The reuseable chip card does not have the memory capacity of the optical storage card and therefore does not contain x-rays or photos. The reusable chip card however can contain all the pertinent information for traveling executives and interface through a simple read/write mechanism of most personal computers and therefore be easily available to doctors and hospitals world wide.

5.2 FINANCIAL

The French and Japanese Smart cards have been designed with the financial industy in mind. The Key objective is to replace all credit cards and automatic teller machine debit cards with smart cards. Trials for banking have already been held in France. A number of financial experts have been trying to size the loss in dollars due to credit card fraud, abuse and theft the estimates range from $100 million per year to $600 million.

The Key to the success of the smart card in the financial industry is the Mastercard trial at the First National Bank in Palm Beach and Ft. Lauderdale. Both Casio and Honeywell Bull through their U.S. affiliates will be participating. Each will supply up to 50,000 cards and 200 readers before the trial is complete. The card will be used as a Mastercard Gold card and 10,000 cards will be issued initially. The debit functions of the card will also be tested.

The card will be used to record each financial transaction through a Point of Sale terminal located at various retailers. The card will store a running account balance. The Mastercard Objectives are to understand the customer acceptance, both cardholders and merchants, test the cards security properties, define what education is required and to understand the Systems integration requirements since the new smart card capability must be integrated completely into the electronic payment system. This includes the need for systems software changes.

The results of the test is to allow Mastercard to develop specifications and standards that are to be met by all card suppliers and used to certify such suppliers. The specifications will also be used as well as the certifed supplier list to recommend such smart cards and terminals to the member banks.

A Key to this type of financial test is the reliabilty of the card and if it is recommended that a reuseable EEPROM card be a requirement as opposed to the current EPROM Smart Card which is not reusable.

Other financial institutions such as brokerage houses and other companies that have credit cards have interest in a re usable chip card in particular for key accounts with major stock, bond and money portfolios.

5.3 SECURITY- The security industry and the telecommunications industry is predicted to be the first to use the chip cards commercially in the United States. The Security applications require ruggedized cards with the chips completely encapsulated. Both physical and electronic security is required. The primary use of the card is as an access Key to high security areas, whether they are buildings, rooms, containers, terminals or computer data banks. The card can also be used to identify the holder through what is known as biometrics and includes signature, thumb print, hand geometry and voice print. Both the Smart card and Memocard can be used in these applications.

For applications where the Security Card is used for multiple applications the reusable card is required. For Single Security applications, depending on their complexity either the EPROM or EEPROM chip card can be used.

6. TERMINALS WITH CARD CAPABILITY - currently a number of terminals are commercially available and others are in test mode. The terminals that are commercially available include voice, data and some PC attachments.

6.1 VOICE - The pay telephones in France for the smart card are becoming commercially available. The business and consumer integrated data storage/voice terminals developed by Multimil for the Memocard are commercially available in Europe and the U.S. and have been homologated in the major European countries and certified by the FCC in the U.S.

6.2 Data- The primary data terminal at this time is the Videotex terminal available in France. Other data terminals for individual corporate networks may look to the chip card technology for similar enhancements as it gives to voice terminals.

6.3 Financial- The Key terminal developed at this time is the point of sale terminal. The terminal must have the capability to read both the magnetic strip and the smart card as well as write to the smart card. Other terminals being considered and in test mode are the Automatic Teller Machine.

6.4 PERSONAL COMPUTERS - Input/output devices have been developed for the optical data card, the smart cards and the Memocard to attach to personal computers. The PC's can read, write and instruct the cards based on the type of card and be used as a terminal device with the card as an adjunct. At this time all card manufacturers have announced products with this capability and both smart card and Memocard manufacturers are delivering.

7. CONCLUSION - The chip card in particular the card with EEPROM and a Micro is truly an 8 bit computer with 8k bytes of memory. It is the first of a new line of totally portable computers. Together with future miniaturized Input/output devices and new software to make uses simple the chip card will bring the benefits of sophisticated technology to all. It is expected that more than one chip card will be carried by most people in the future and that a simple device such as the telephone will enable the user to read, write and instruct the card as well as transmit and receive information to and from the card. This paper has only touched the surface of the memory card and chip card applications and capabilities.

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Value Added Network Service
Employing High-speed Digital Circuits

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Abstract

Dereguration of telecommunications industry in Japan enabled private firms to set up and operate value added networks available for general use by the public. This paper describes the network configuration and service plans of Fujitsu's VAN, one of the largest VANs in Japan. The network uses high-speed digital circuits.

1. INTRODUCTION

The information network system environment in Japan is facing a revolution. In paticular, dereguration in the telecommunications business has had a considerable impact. More than 150 companies are entering VAN business. This holds great promise for many new types of services, and is changing the character of conventional corporate information network systems. It will also significantly affect future corporate activities and strategies.

This paper shows the changes of telecommunications business in Japan, and the VAN services which Fujitsu will provide.

2. THE CHANGES OF TELECOMMUNICATIONS BUSINESS IN JAPAN

April 1, 1985 was the day when the new Telecommunications Business Law was enforced. Until then, VAN services had been in the hands of Nippon Telegragh & Telephone (NTT), except some specific fields. That is, VAN services had been limited to the services for small or medium sized companies. But, with its market liberalization, VAN business were widely opened to Japanese and foreign competitors. To insure the competitive system, the steps had been taken to denationalize NTT, making it a private corporation. In the new telecom law, two types of business are defined. One is the first-class telecommunications business conducted by the companies who own circuits and provide services, and the other is the second-class telecommunications business conducted by the companies who provide services using circuits leased from the companies of the first-class. Furthermore, the second-class is divided into the special second-class, which is intended for unspecific users and large-scaled, and the general second-class, which is intended for specific users or small-scaled.

Table 1 gives details of the new telecom law, and Table 2 shows how the telecom business legal system has changed.

3. THE PROJECT OF FUJITSU IN TELECOMMUNICATIONS BUSINESS

Fujitsu has been concentrating its computer & communication technologies to cope with customer network needs. Customer network needs are classified into following three types:

- Needs to set up and operate its own network
- Needs to set up its network using a VAN
- Needs to enter VAN business to enhance its business chance

To satisfy these customer needs, we provide following products, services and know-how.

(1) COINS (Corporate Information Network System)

This system is designed to realie the following:
- Easy and simple operations
- Integrated multifunctional terminals
- New services
    - High-speed transmission ofbulk data
    - Video transmission
    - Media storage (mail service)
    - Conversion (speed, protoco, media)
- Network expansion
- Advanced communication betweencompanies

In an integrated information sysem, it is very important to construct an iformation network system which can reduce ommunication costs and operation and maintenace costs. COINS is a Fujitsu's concept covring both equipment and engineering technoogy necessary for constructing an inormation network system. Individual netwrks such as telephone and data networks are itegrated into a multimedia network by COIS, based on a digital network.

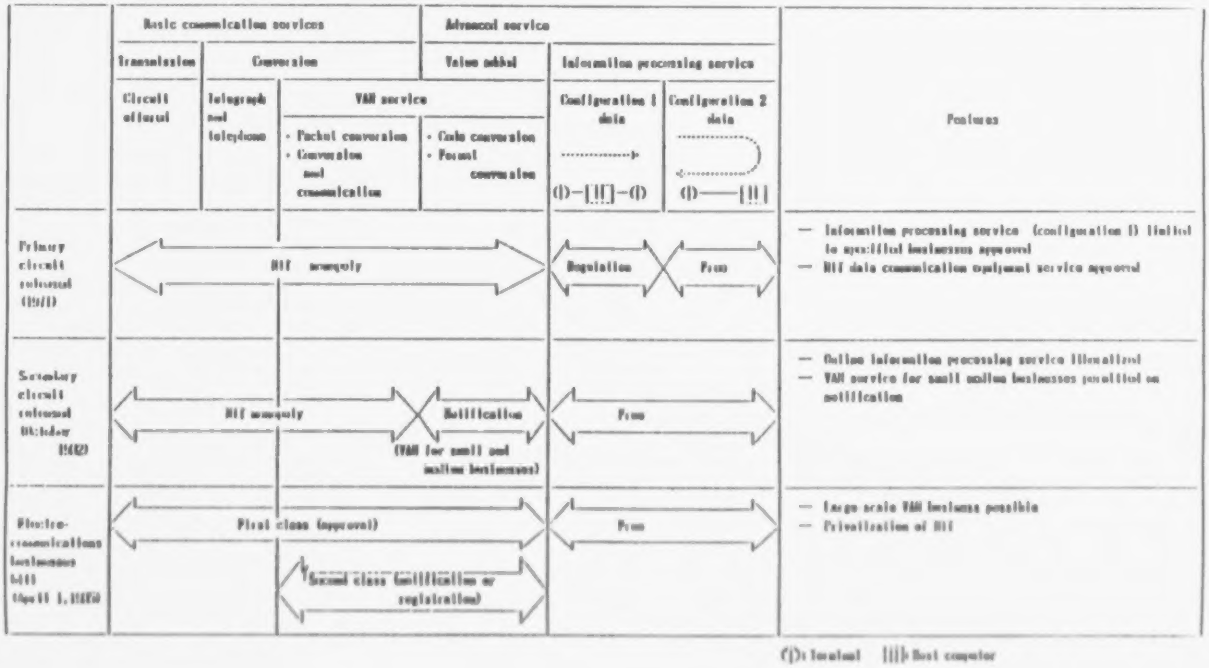
Figure 1 shows the outline of COIS.

(2) FENICS (Fujitsu ENhanced Informaion & Communication Service)

Table 1 PRINCIPAL REGURATION IN THE TELECOMMUNICATIONS BUSINESS LAW

Category feature and restrictions		First-class telecommunication business	Second-class telecommunication business	
			Special second class	General second class
Telecommunications line facilities		Personally owned	Leased from first-class telecommunication vendor	
Restrictions	Start of operations	License system	Registration system	Notification system
	Condition for offering (fees and other)	Approval system	Notification system	Unrestricted
	Foreign capital ratio	Less than 1/3	Unrestricted	
Details of service offered		Telephone, facsimile, data, VAN, etc (No distinction between first and second class)		

Table 2 CHANGES IN THE LEGAL SYSTEM IN JAPAN



	Basic communication services			Advanced service			Features
	Transmission	Conversion		Value added	Information processing service		
	Circuit offered	Telegraph and telephone	VAN service		Configuration 1 data	Configuration 2 data	
			• Packet conversion • Conversion and communication	• Code conversion • Format conversion	(|)–[||]–(|)	(|)——[||]	
Primary circuit released (1971)	NTT monopoly				Regulation	Free	— Information processing service (configuration I) limited to specified businesses approved — NTT data communication equipment service approved
Secondary circuit released (October 1982)	NTT monopoly			Notification (VAN for small and medium businesses)	Free		— Online information processing service liberalized — VAN service for small medium businesses permitted on notification
Electro-communications businesses bill (April 1, 1985)	First class (approval)		Second class (notification or registration)		Free		— Large scale VAN business possible — Privatization of NTT

( ): terminal [ ]: host computer

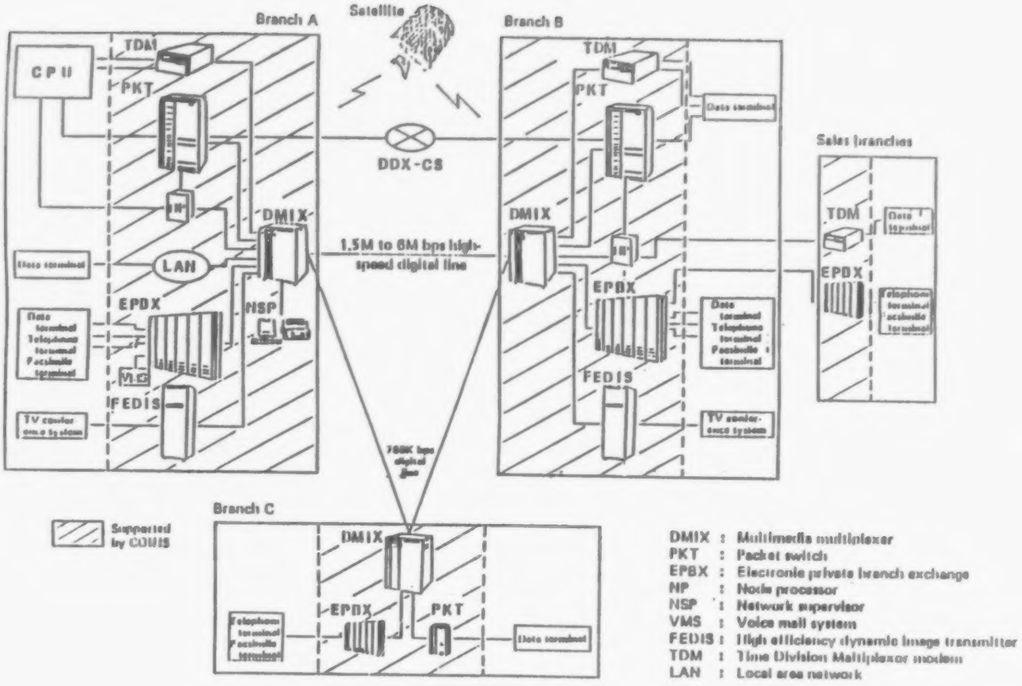

Satellite
Branch A
Branch B
Branch C
Sales branches
CPU
TDM
PKT
NP
DMIX
LAN
EPBX
NSP
VMS
FEDIS
DDX-CS
1.5M to 6M bps high-speed digital line
768K bps digital line
Data terminal
Data terminal Telephone terminal Facsimile terminal
TV conference system
Telephone terminal Facsimile terminal
Supported by COINS
DMIX : Multimedia multiplexer
PKT : Packet switch
EPBX : Electronic private branch exchange
NP : Node processor
NSP : Network supervisor
VMS : Voice mail system
FEDIS : High efficiency dynamic image transmitter
TDM : Time Division Multiplexor modem
LAN : Local area network

Figure 1 OUTLINE OF COINS

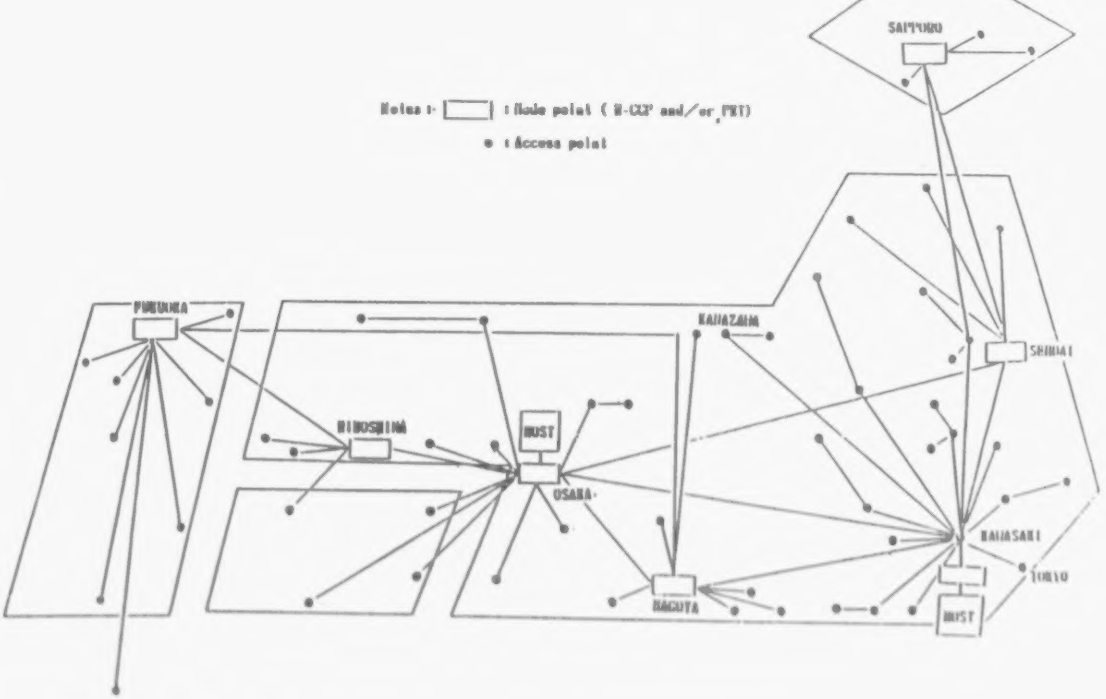

Notes : ▭ : Node point (M-CCP and/or PKT)
● : Access point
SAPPORO
FUKUOKA
HIROSHIMA
HOST
OSAKA
KANAZAWA
SENDAI
NAGOYA
KAWASAKI
TOKYO
HOST

Figure 2 NETWORK CONFIGURATION OF FENICS

Features of FENICS are following:

- Total service

  FENICS provide not only conventional VAN service but also information processing or communication services to meet diversified user requirements.

- Intra/inter industry service

  FENICS provides optimized VAN service for industries such as textile, apparel, food & beverage and credit services, using know-how obtained from system developement experiences with customers.

- Multimedia service

  Fujitsu are planning to expand its service media in the future, covering data, voice, facsimile and video signals.

(3) Know-how

For those who want to enter VAN business, we will provide constructing and operation know-how of FENICS.

4. NETWORK CONFIGURATION OF FENICS

FENICS network is based on the network equipments of COINS, and is composed of access points, switching centers, processing centers and digital circuits.

Figure 2 shows the network configuration of FENICS.

(1) Access points

Access points connect network customers with FENICS network. Users can access FENICS by local dial access to access points located in cities populated more than 100,000 people. FENICS permits user host computers or terminals to be connected directly to FENICS network via a dedicated circuit. Data transmitted to access points are concentrated by an inteligent TDM or digital multimedia multiplexer and transmitted to a switching center or processing center.

Figure 3 shows the configuration of an access point.

There are 43 access points at the point of October, 1985. The number will increase up to 200 by the end of fiscal 1987.

(2) Switching centers

Switching centers are located at in 5 large-populated cities. Data transmitted from access points are relayed to FENICS center by packet switch. There are multiple node-node links between neibouring centers. Every swithing center has automatic alternate routing function in the event of a link failure.

Figure 4 shows the configuration of a swithing center.

(3) Processing centers

Processing centers are located in Tokyo and Osaka. (Osaka center is not in service now.) Both centers have multiple very large-scale computers to provide various services to many users.

5. SERVICE HIERARCHY OF FENICS

The services of FENICS consist of network services and application services.

(1) Network services

Network services include:

- Packet switching service

  This service provide packet multiplexing and switching functions which conforms to CCITT X.25 specifications.

- Realtime connection service

  This service provides user terminals or host computers with conversion service such as speed, protocol and code.

- Store and forward service for file data

  This is a file data exchange service with speed, protocol, code or format conversion. In addition to this, services such as schedule control of data collection or delivery, and sort/merge by destination address or data type are provided.

(2) Application services

Application services include:

- Intra/inter industry service

  These are the services for industries such as textile, apparel, food & beverage and credit services, based on data exchange service between companies. Services for apparel industry will be described in more detail later.

- Remote computing service

  This is the service for users to develope

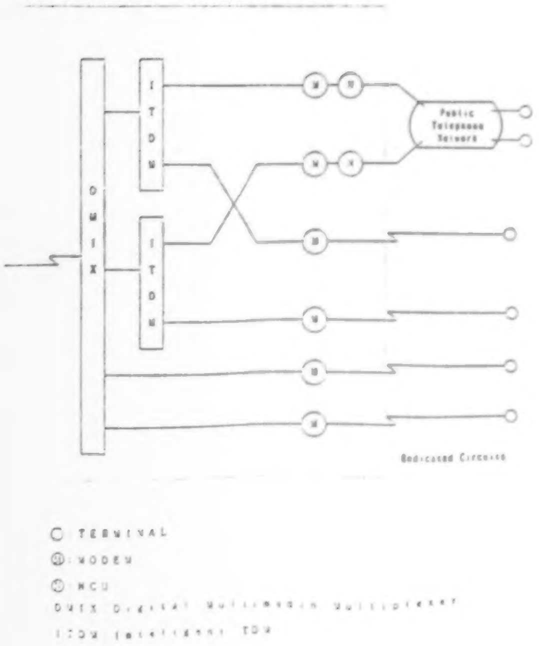

DMIX
ITDM
ITDM
M
N
Public Telephone Network
Dedicated Circuits
○ TERMINAL
Ⓜ MODEM
Ⓝ NCU
DMIX Digital Multimedia Multiplexer
ITDM Intelligent TDM

Figure 3 CONFIGURATION OF ACCESS POINT

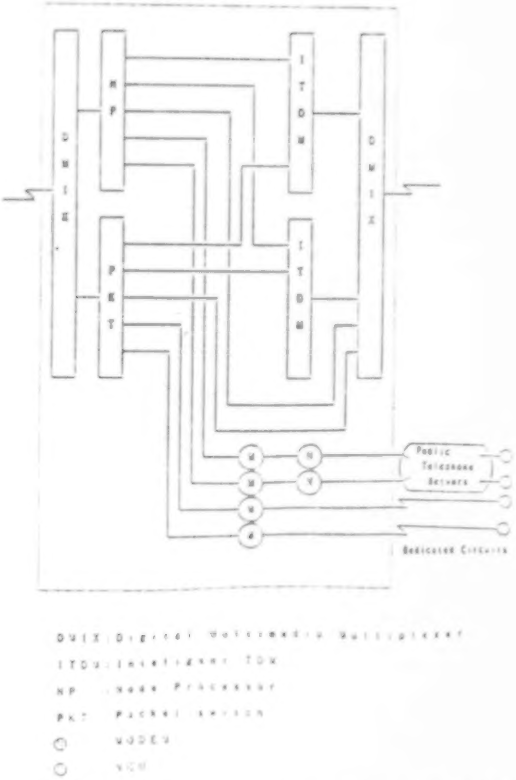

DMIX
NP
PKT
ITDM
ITDM
DMIX
M
N
Public Telephone Network
Dedicated Circuits
DMIX Digital Multimedia Multiplexer
ITDM Intelligent TDM
NP Node Processor
PKT Packet switch
○ MODEM
○ NCU

Figure 4 CONFIGURATION OF SWITCHING CENTER

Application services			
Intra/inter industry service	Remote computing service	DB service	Communication service
For - Textile - Apparel - Food & bverage - Credit services	Time sharing service Remote job entry	DB DB gateway link	Electronic-mail Voice-mail Facsimile-mail

Network services		
Packet swithing service	Realtime connection srvice	Store & forward srvice for file data

Figure 5 SERVICE HIERARCHY OF FENICS

programs or proceed user business, using hardware and software resources of FENICS center. Time sharing service and remote job entry service are provided.

- Database service

  Two types of DB service are provided. One is the type which offers some databases installed in FENICS center, and the other is gate way link service to external databases. In case of gate way link to oversea databases in the future,we are planning to add machine translation service.

- Communication service

  Communication service consists of electronic-mail, voice-mail, facsimile-mail and television conference. At the moment, electronic-mail is in service. Electronic-mail service will be described in more detail later.

Figure 5 shows service hierarchy of FENICS.

5.1 SERVICES FOR APPAREL INDUSTRY

Due to the slump in the demand for textile goods, the sales of the apparel manufacturers have not incresed in these years. Profits rates have also fallen because of intensified competition, and the business climate over the whole industry has deteriorized. The values of consumers are diversifying and changing rapidly as new fashions, and it is very important for the companies to come to grips with production of a wide range of items in small quantities to accomodate the consumer demand.

The expectations from VAN are as follow:

- United management and quik collection of information scattered in wide area

- Reinforcement of connection with business customers by quick information interchange

- Improvement of office work by reducing paper work

- Efficient system developement and operation

5.1.1 CONTENTS OF SERVICES

Following five services are provided for apparel makers:

(1) Shop information service

FENICS collects various information from their business customers such as department stores, specialist stores and chain stores scattered nation-widely.
Information include:

- POS data/returned goods data/price reduction data
- Information of goods laid-in and returned
- Stocktaking data
- Information of money received and paid on cash registers

In this data exchange service, following processes are included:

- Duplicated data check
- Totalizing number of goods or amount of money shop by shop or item by item
- Format conversion
- Postponing of undelivered data
- Dispatching of data collected by hand-held terminals to branch offices
- Data collection for operation analysis
- Preservation of file data by user request

(2) Received orders information service

FENICS provide apparel makers with received orders information from their business customers.

(3) Consumer information service

Consumer information such as name, address, sex, age and amount of purchase are provided.

(4) Data exchange service between apparel makers and sewing firms

Transaction data between apparel makers and sewing firms include:

- Data of order/arrival of goods
- data of works in process
- Billing/payment data

(5) DB gate way link service

DBs on market trends, consumer trends and various statistical data will be provided.

Figure 6 shows the outline of services for apparel industry.

5.2 COMMUNICATION SERVICE

As a communication service, electronic-mail service is being implemented at the moment. FENICS electronic- mail service is a store-and-retrieve system using 'electronic mailbox'. Messages are accepted by the network without actually delivering them to the addressee. They are filed in the storage facility and retained until the addressee retrieves them.

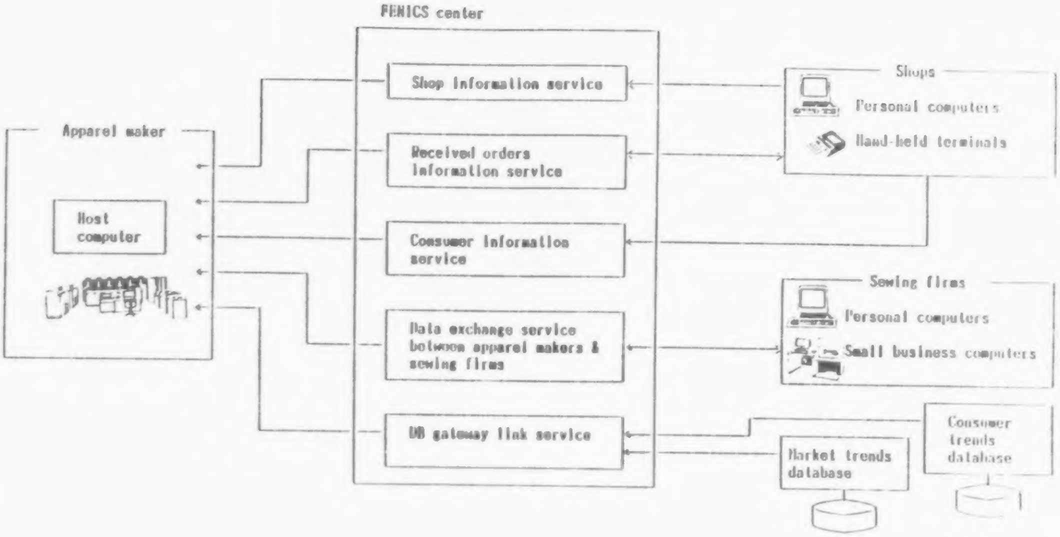

FENICS center
Apparel maker
Host computer
Shop information service
Received orders information service
Consumer information service
Data exchange service between apparel makers & sewing firms
DB gateway link service
Shops
Personal computers
Hand-held terminals
Sewing firms
Personal computers
Small business computers
Market trends database
Consumer trends database

Figure 6 OUTLINE OF SERVICES FOR APPAREL INDUSTRY

Users of the system have to check their mailbox regularly for messages received; the obvious advantage is that they can retrieve messages when it is convenient; moreover, they can retrieve their mail from any location with access to a terminal connected to the network.

(1) Features

- Menu driven style

  Users don't need to know complicated commands to operate. Users can send or receive messages responding to the system guidance.

- Security check

  There are three level password check for security.

(2) Services

- Standard mail

  A user can send one or more messages to one or more addressees at one time. He can designate the delivery date, until when the addressee cannot retrieve the message, and the expiration date, after when the addressee cannot retrieve the message.

- Circular mail

  A user can send one or more messages to addressees, designating order they retrieve the message. When an addressee has read the message, he can pass it to the next addressee.

- Bulletin board

  A user can send one or more messages on 'electronic bulletin board', and any user can retrieve the messages.

6. CONCLUSION

This paper has summarized the changes in telecommunications business in Japan, and outlined Fujitsu's VANservice using high-speed digital circuits.

Tens of thousands of VANs may eventually be established in Japan. As VAN service providers build up their businesses, manufactures of mainframe computers and other sophisticated communications equipment will also profit. As competition flourishes, Japan's telecom environment will mirror that of the U.S. after AT&T was divested : prices will come down and the choice of service will grow quickly.

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EXPERT SYSTEMS IN TELECOMMUNICATIONS

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1. ABSTRACT

The emerging concept of Intelligent Networks is placing an increasing demand on telecommunications network capabilities in reliability, efficiency, and flexibility. Expert Systems (a subfield of artificial intelligence) offers "brainpower" to computer systems by allowing human expertise to be encoded into computer programs. This technology promises enormous reliability, performance, and productivity improvements in telecommunications networks, with the various socioeconomic impacts as side effects. In this paper, we examine applications of the technology and speculate on its ramifications, economic and social.

2. INTRODUCTION

Artificial Intelligence (AI) is an emerging technology demonstrating a great deal of potential for use in product and service industries. Expert systems is a subfield of artificial intelligence in which the expertise of a top expert in a particular area is encoded into a computer system, making the expertise available to nonexperts to upgrade their performance. Presently artificial intelligence is considered a speculative field with very high potential. Although there are only a few successful experiences using artificial intelligence in an industrial environment, several new expert systems are reaching the field use and deployment stages. The technology offers great potential for telecommunications applications.

3. WHAT IS AN EXPERT SYSTEM?

An expert system is a computer program with a difference. The program contains the explicit information on what to do (e.g., a list of rules) without specifying how to do it. It is divided so that the program control and the knowledge used to reach a conclusion (e.g., the rules) are kept separate. New knowledge can be added at any time without altering the control part of the program. The fact that "how" and "why" of the program are separate distinguishes the architecture of expert systems from that of conventional computer programs.

The architecture of an expert system can be thought of as consisting of three main parts.

The first part is the knowledge base. A knowledge base is made up not only of facts, but also of instructions on how and when to use those facts and how they relate to each other. The knowledge in the knowledge base contains the expertise required to solve the problems. The second part is the working memory which contains the information that the system receives and derives for the specific problem at hand. The third part is the inference engine which draws inferences based on the knowledge in the knowledge base and data for the specific problem. The inference engine is a computer program that manipulates arbitrary symbols, symbols that can stand for ideas, not just numbers. A complete expert system also requires a friendly user interface for inputting the data and outputting the results.

These components of knowledge systems are supported by high-level programming languages such as Lisp or Prolog, and specialized machines (Lisp machines) supported by high-resolution graphics and editing systems.

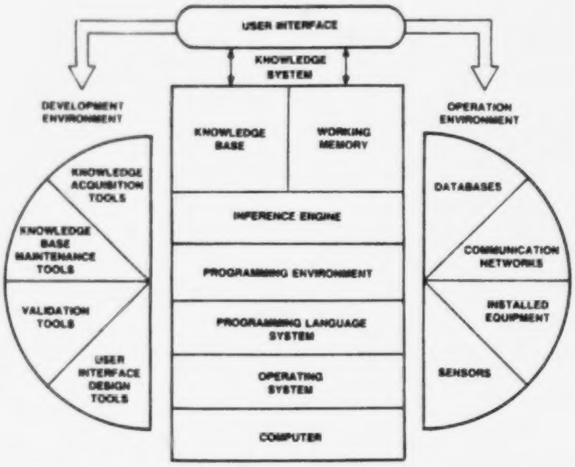

Figure 1. Major components of a contemporary knowledge system. With the development tools, knowledge is acquired and maintained, and then put into operation.

The underpinnings of an expert system are in knowledge representation and problem-solving strategies involving search, control, planning, and learning techniques. Figure 1 shows a complete expert system with its development and operational environment. Since knowledge is what distinguishes an expert system from a conventional computer program, fairly sophisticated knowledge acquisition, validation, and maintenance tools are desirable as part of an expert system development environment. The operational environment deals with databases and sensors through communication and data transmission links.

4. EXPERT SYSTEMS IN NETWORK MANAGEMENT

One important area where expert systems might be used in telecommunications is in network management. Network operations and management, a domain rich with potential expert systems and artificial intelligence applications, has only recently begun to be explored. Exploration has been slow to start because up until recently, only modest demands were being placed on telecommunication networks. The use of conventional communications and switching technology forced the design of network architectures which could be easily modeled, centrally controlled, and cheaply maintained. New demands for communication services, the hardware built to meet these demands, and the proliferation of new software-controlled networks have opened the door for untraditional approaches to network management.

Network management is the process of optimizing the call carrying capacity of a telecommunications network at all times and minimizing network performance deterioration when the load (traffic) and network conditions (switching and transmission system) are temporarily out of balance. The objectives of network management, therefore, are to maintain a uniform flow of traffic in the network at the near capacity of the system facilities and to minimize congestion under the varying traffic conditions.

Today's complex telecommunications networks are more than a conduit for carrying bit patterns from Point A to Point B. With the emergence of "Intelligent Network" concepts, more demands are being placed on network capabilities demanding higher levels of performance, efficiency, switching reliability, and tighter network management and control.

Network behavior means different things to different people. First we will examine some of the views of the networks and the corresponding requirements in terms of intelligent behavior

5. VIEWS OF A NETWORK

There are at least three views of the networks, based on the user: the end user's view, the operator's view, and the network designer's view.

5.1 END-USER'S VIEW

The end user views the network as an interface to intelligent telecommunications and transaction services, as well as a conduit for carrying voice and data. The network must offer a user-friendly (with semantic, and pragmatic processing capability) interface to various database services and mail systems. The intelligent interfaces should know the user! Purely as a communication medium, the network now, but more so in the future, will be required to offer services such as selectable quality and bandwidth and cost selectable network facilities, with a high level of reliability.

5.2 NETWORK OPERATOR'S VIEW

The objectives of the network operator are to offer a high level of performance and reliability at an affordable cost. This requires near-optimum utilization of network facilities under traffic carrying conditions. As such, intelligent subsystems for network fault isolation and recovery, performance analysis, routing and congestion control, network security, capacity planning, call processing, and billing are valuable in achieving these goals. From the network operator's viewpoint, using the least cost routing is important.

One of the intelligent subsystems that may be effectively used in a system is a network state analyst, which is an intelligent system for assessing the network status by monitoring such information as the level of traffic, facilities, controls that are operational, and trouble indicators. This could present network state information to network managers at varying levels of detail, based on their needs and the current network state.

5.3 NETWORK DESIGNER'S VIEW

The network designer wants the network to be robust, easy to maintain, analyze, reconfigure, and expand. From a designer's viewpoint, modeling and analysis, service impact studies, and pre-plan construction and evaluation tools are most valuable. Expert systems have been employed or hypothesized for many of these applications in other domains. Intelligent simulators, which generate simulation algorithms based on the system aspects being studied, are just one of these systems. In addition, several of these capabilities can be provided by using specific multiple expert systems in the networks.

6. EXPERT SYSTEMS APPLICATIONS

A variety of expert systems to provide design, analysis, diagnosis instruction, and management functions have been reported in the last few years. Table 1 highlights some important systems, showing the status and accomplishments of each.

Selection of an appropriate application[1] domain is one of the very important tasks in the development of expert systems. Several of the early expert systems were built in the domain of medicine, primarily for diagnosis tasks. Current applications include interpretation/diagnosis, monitoring, planning, design, prediction, and control. More recently, network operations and management has received special attention for expert systems applications. Currently, AT&T's ACE[2] and GTE's *COMPASS* are the most advanced expert systems undergoing field tests in the network domain. The following section discusses the *COMPASS* system as an example of an expert system development method and an application for the network domain.

Table 1
Some expert systems

DART	— Assists in diagnosing faults in computer hardware systems Developed — Stanford University Implemented — MRS Status — Research prototype
XCON	— Configures VAX 11/780 computer systems Developed — Carnegie-Mellon/DEC Implemented — OPS5 Status — Mature
XSEL	— Helps a salesperson select components for a VAX 11/780 computer system Assists in designing a floor layout Developed — Carnegie-Mellon/DEC Implemented — OV85 Status — Field prototype
ACE	— Identifies trouble spots in telephone networks and recommends appropriate repair and rehabilitative maintenance Developed — Bell Laboratories Implemented — OPS4 and FRANZ LISP Status — Mature
COMPASS	— Analyzes telephone switching system maintenance messages for GTE's No. 2 EAX switch and suggests maintenance actions to perform Developed — GTE Laboratories Implemented — KEE and INTERLISP-D Status — Field prototype

7. GTE'S COMPASS EXPERT SYSTEM

COMPASS (Central Office Maintenance Printout Analysis and Suggestion System) is an expert system developed at GTE Laboratories.[3-5] *COMPASS* performs an expert analysis of maintenance printouts of a telephone company central office switch (GTE's No. 2 EAX), suggests maintenance actions in expert priority order, and justifies the suggested actions. The faults are identified up to a circuit card, switching relay, or wiring pin level.

A central office telephone switch such as the No. 2 EAX produces hundreds of maintenance messages daily. In GTE telephone companies, the output messages from the No. 2 EAX are collected, sorted, and reformatted by GTE's Remote Monitor and Control System (RMCS), as shown in Figure 2. Telephone maintenance personnel analyze the RMCS printouts to determine maintenance actions. In the present manual operation, maintenance personnel analyze the day's data in a batch mode and perform the maintenance actions which they deem appropriate. These manual procedures require a high level of expertise. Personnel with greater expertise (with judgement and rules-of-thumb accumulated over years of task performance) and greater ability can perform the analysis significantly better and in substantially less time than those with less expertise.

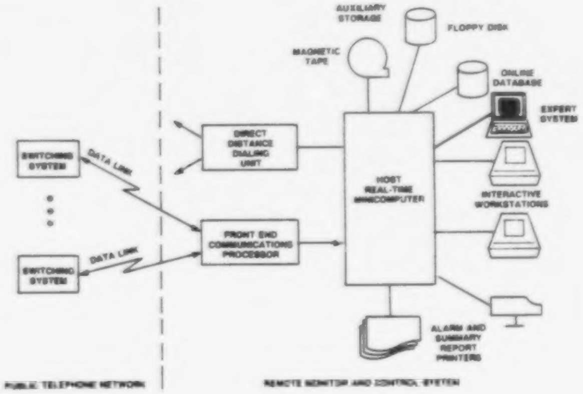

Figure 2. RMCS and public telephone network.

COMPASS captures the knowledge utilized by a top switch expert to perform the maintenance printout analysis task. It thus replaces the manual mode of maintenance printout analysis, as performed by maintenance personnel of varying abilities and experience, with an automatic mode of analysis and selection of maintenance actions, performed at or above the level of a top expert. By automating the expertise of a top expert, *COMPASS* considerably reduces the time (up to one or two hours) that is being spent by a nonexpert maintenance person in doing the analysis. Furthermore, it upgrades the results of the analysis, finding switch problems that an average maintenance person may not find. This also saves a good deal of time that might be spent in continually reanalyzing a problem over weeks or months. In addition, since *COMPASS* ranks the maintenance actions and selects the best possible maintenance action to be performed first, time is saved that would otherwise have been spent performing maintenance actions unlikely to solve the problem. *COMPASS* thus upgrades the performance of less experienced maintenance personnel. It also allows lower skilled personnel to perform the task, thereby freeing experienced technicians to tackle the more difficult problems or to learn newer technology. It reduces the need for having experts available around the clock.

There is a large amount of expertise required by an analyst, and therefore by *COMPASS*, to analyze a No. 2 EAX maintenance printout and to determine and prioritize maintenance actions. This includes: (1) Grouping of maintenance messages, so that all messages in a group are likely to be caused by a common switch fault; (2) Analyzing the messages in a group to determine the specific switch faults that could be causing the messages; (3) Estimating the likelihood of occurrence of the possible faults; (4) Determining the possible maintenance actions to fix these faults; (5) Prioritizing the actions list by considering fault likelihood, ease of action performance, and possible risk of the action;

(6) Merging items on the actions list to combine maintenance actions which can be performed together; and (7) Specifying output in a format and language most appropriate for switch maintenance personnel.

To obtain the knowledge needed by *COMPASS*, the development team has been meeting with a No. 2 EAX expert from General Telephone of the Southwest for one week per month since May 1984. Through these interactions, the procedures and rules the expert uses to analyze an important subset of the No. 2 EAX's maintenance messages were identified and formulated. *COMPASS* system performance at a near-expert level has been evaluated and initially verified through developmental testing, peer expert review, and several formal field trials. In each of these trials, *COMPASS* has successfully identified and suggested the appropriate repair actions for the faults in the switches, including faults that had eluded local experts for one month or more. The *COMPASS* system is being transferred to GTE Data Services (GTEDS). GTEDS is a part of GTE, responsible for generating and maintaining software for GTE telephone operations. GTEDS has been putting *COMPASS* into field use on a production basis, and will be responsible for maintaining *COMPASS* in the future. At the same time, the initial version of *COMPASS* is being expanded by GTE Laboratories (with GTEDS' assistance) to increase its breadth of coverage, and the system is being redesigned and reimplemented.

8. POTENTIAL BENEFITS OF TELECOMMUNICATIONS EXPERT SYSTEMS

In the following section, the potential benefits (economic and socioeconomic) of a telecommunications expert system have been grouped into three categories: providing higher quality service, providing lower cost service by productivity improvement, and other benefits.

Providing Higher Quality Service

- **Substantially increases performance.** Routine use of expert systems for network routing, system maintenance, etc., would significantly improve the performance of telecommunications systems. It would allow personnel and computer systems to perform at or above the level of an expert. From the customer's standpoint, it should yield a better product or service with a higher level of reliability.
- **Captures knowledge that will be less available in the future.** This is an important, though difficult to quantify, benefit. In the dynamic world of telecommunications, expertise is being lost as experienced personnel move to work on new systems or new problems, or just leave the company. This generates potential problems in the utilization of older systems. An expert system can capture the expertise of a top expert while he is available and at peak performance, and make it available for the future.
- **Makes expert performance available at all times in all locations.** The expert system performs at the same high performance level 24 hours a day, in all locations.

Providing Lower Cost Service by Productivity Improvement

- **Significantly increases productivity.** An expert system can bring a less experienced person to the level of an expert, allowing tasks to be performed faster and more efficiently. Even experienced personnel can be aided, as they are still not at the level of a top expert.
- **Reduces staffing costs and makes top performers available.** With an expert system, some high-level jobs could be performed by lower graded (and thus possibly lower paid) staff. This also frees the top (experienced) performers to concentrate on the more important jobs, which may be beyond the reach of the present state of the art of expert systems.
- **Expert systems can often do better than an expert.** Expert systems can combine the capabilities of the computer with the expertise of a top expert. Thus, expert systems can do a complete analysis of a complex situation, which is difficult even for an expert. Being a computer system, an expert system is thorough in all its analyses and will not make errors which average maintenance personnel may make and which even the best human expert will occasionally make. Also, an expert system can do the detailed, repetitive, or laborious tasks that an expert, though capable, often might disregard if he feels that they have only a small chance to help solve the problem.
- **Improves worker's general performance by having the presence of an expert review.** When the expert system is used to make recommendations related to a worker's task, the worker subconsciously may be more careful in his work, so as not to be "caught" doing a poor job by the expert system.

Other Benefits

- **Provides management and supervisors with greater flexibility in staffing.** Since the required skill level may be lowered for certain jobs, management and supervisors can, at times, use personnel with skills in one area to work on a related area, with the assistance of an expert system.
- **Expert systems can be a major aid in training.** Expert systems often can output explanations and justifications of their analyses, in many levels of detail. This can be a major aid in training inexperienced personnel. In addition, some expert systems have been developed specifically for training, having the expertise of a trainer as well as the application expertise.
- **The use of artificial intelligence enhances the image of the company.** There is presently a great deal of interest nationally and internationally in the field of artificial intelligence. The use of artificial intelligence and expert systems for real applications enhances a company's image as a leading technological industry. It also improves the image with employees, who can feel they have access to the very latest in technology.

9. POTENTIAL PROBLEMS IN INTRODUCING EXPERT SYSTEMS

Though expert systems offer significant advantages to the industry, those introducing the system must be careful about several things:

- As with the introduction of any automation, expert systems may create a feeling of insecurity among workers. If expert systems are not carefully implemented, it could lead to social problems in changing the way things are done due to the deviation from the "business as usual." In order to avoid this situation, the system and the technology should be introduced gradually, in a natural mode.

- Expert systems are not sensitive to political situations. It can sometimes produce results politically damaging to someone and therefore could be the subject of embarrassment. It may be important to employ expert systems in a subordinate role; in a decision support mode.
- Finally, there is a problem with the unrealistic expectations. The area of AI and expert systems has many people expecting too much and others expecting too little. It is important to avoid too much emphasis on cost/benefit analysis in the early stages. Unrealistic expectations must be avoided at all cost.

10. FUTURE APPLICATIONS

The increasing complexity of networks and the need for exhibiting intelligent and reliable behavior suggests an increasing potential for the use of expert systems in telecommunication networks. By providing intelligence at various critical decision nodes, the intelligence can be distributed, thus reducing the need for internode communication during the decision support and reasoning. A nonhierarchical network such as this may be able to control its own parameters and performance through cooperative communication between nodes. Figure 3 depicts such a "futuristic" network conceptually. In principle, a well-designed "intelligent" network could be self-contained and self-healing, providing graceful degradation in performance in an overload situation. Other possible applications to telecommunications are in maintenance, planning, operations, sales, management, and marketing. These can have a profound impact on the way our networks are operated and controlled.

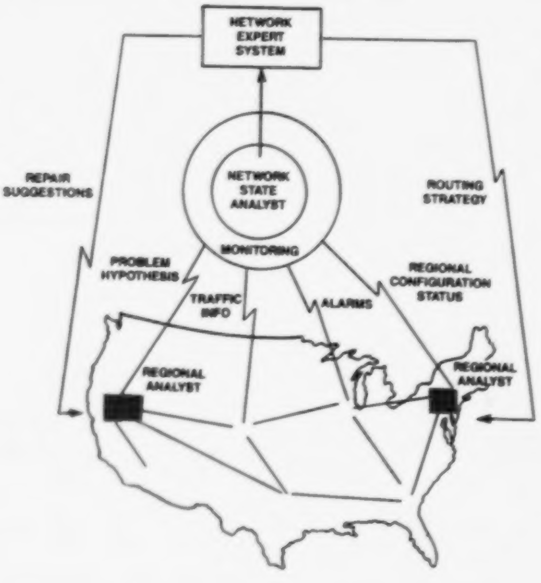

Figure 3. A futuristic network.

Are these realistic expectations? Will it be possible to harvest the fruits of AI and expert systems research investment? These are important and significant questions. For 30-plus years, many researchers have treated artificial intelligence with the greatest of skepticism. However, recently there has been a major shift toward optimism. The recent success of expert systems has given AI new respectability. This optimism is further fueled by several major government-sponsored programs in Japan, Europe, and the USA. The challenge now is to continue on this path of success.

Significant research results are beginning to be reported on techniques that allow machines to deal with analogy and metaphor rather than simply applying rules to a specific set of facts. In order to do common-sense reasoning and to exhibit "real intelligent" behavior, the machines will have to acquire knowledge automatically and learn to self-improve their performance. These are extremely speculative, albeit active areas of research. While limited results are emerging, much remains to be discovered.

There is an unlimited potential for using expert systems in network operations, maintenance, control planning, and many other areas. These applications are being explored today by many major telecommunications organizations. The challenge ahead lies in identifying meaningful applications, developing the technology to a level where it is delivering significantly, and integrating it with current systems and operations. As regards to its influence on our lives, the real social impact of this technology is still a subject of much speculation. However, a little care in its introduction should keep any problems under control while providing significant benefits.

ACKNOWLEDGMENTS

The authors would like to acknowledge the work of Robert Reinke and Alan Gunderson on COMPASS development, which forms a part of this paper. The work of Loretta Sharp and Dan Laukaitis in the preparation and editing of this paper is also gratefully acknowledged.

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Total Digitalization of Telecommunications Network Toward INS

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The epoch-making INS (Information Network System) is now being built by NTT as the telecommunications infrastructure toward the advanced information society. Digital technologies are the core of the INS development, replacing the analog networks with digital networks. This paper describes the transition strategy from existing service-oriented networks to an integrated services digital network as well as essential communications technologies for constructing the INS including the local network structure, protocols and communications processing.

1. Introduction

Nippon Telegraph and Telephone Corporation (NTT) has been directing its efforts toward research and development of a digital system called the Information Network System (INS) [1] as the telecommunications infrastructure for the coming advanced information society. This is a totally digitalized communications system in which transporting, switching and processing capability are suitably distributed to provide a variety of services including telephone, facsimile, visual communication and data communication under integrated rules, tariffs and protocols, as shown in Figure 1. The network has interface with ordinary customer equipment, with private networks such as local area networks, and with computers having various information processing capabilities.

An INS pilot system has been in operation since September, 1984, in the western suburbs of Tokyo. The first INS commercial service will start in fiscal 1985 in Tokyo, Osaka and Nagoya. Following this NTT plans to introduce digital telephone network in all prefectural capitals and other major cities by the end of 1987. NTT's digital network will cover all cities with populations of more than 100,000 by 1990. The INS network will be finally established in 1995.

This paper describes the transition strategy toward the INS network, an integrated services digital network. The essential communications technologies in constructing the INS such as the local network structure, protocols and communications processing, are discussed.

2. INS Concept

NTT has the telephone network, the data network, the telex network and the video communication network, as shown in Figure 2 (a). The data network consists of two different types of networks, circuit switched and packet switched. These networks employ independent switching equipment and circuits.

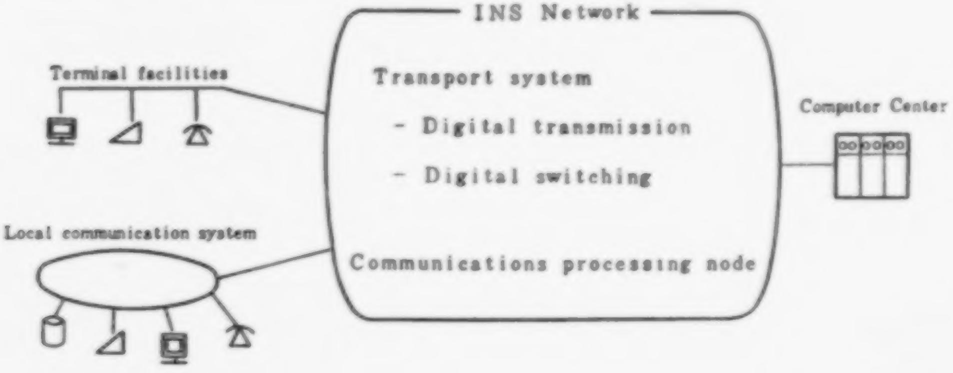
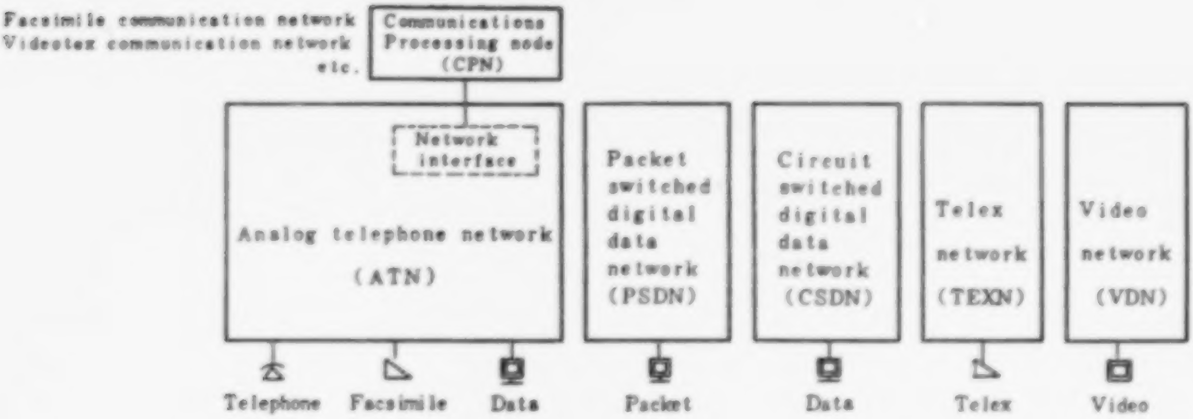
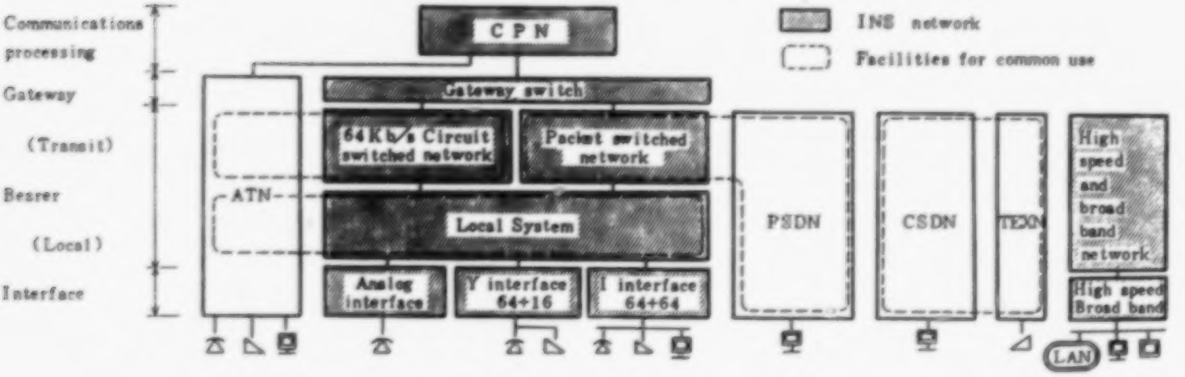


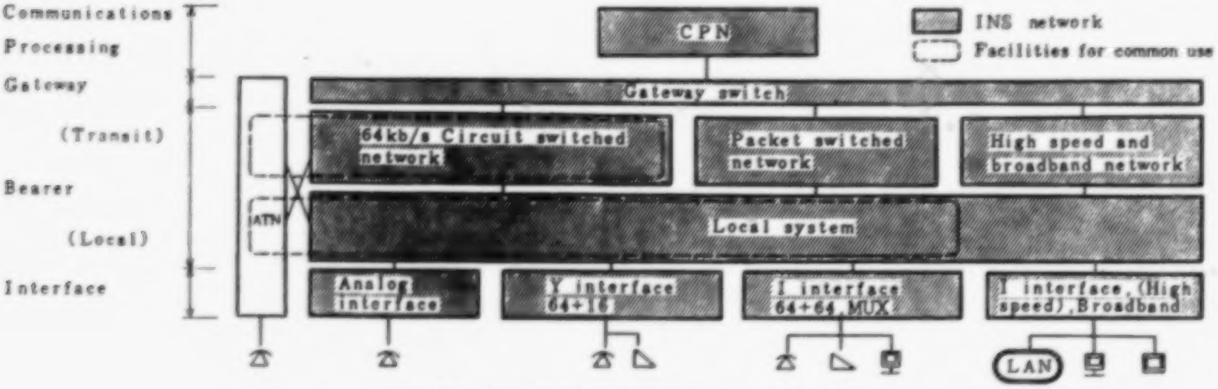
Fig.1 BASIC INS NETWORK CONFIGURATION


Facsimile communication network
Videotex communication network
etc.
Communications Processing node (CPN)
Network interface
Analog telephone network (ATN)
Packet switched digital data network (PSDN)
Circuit switched digital data network (CSDN)
Telex network (TEXN)
Video network (VDN)
Telephone
Facsimile
Data
Packet
Data
Telex
Video

(a) PRESENT (SERVICE ORIENTED NETWORKS)


Communications processing
Gateway
(Transit)
Bearer
(Local)
Interface
CPN
INS network
Facilities for common use
Gateway switch
64Kb/s Circuit switched network
Packet switched network
ATN
Local System
Analog interface
Y interface 64+16
I interface 64+64
PSDN
CSDN
TEXN
High speed and broad band network
High speed Broad band
LAN

(b) EXPANSION STAGE


Communications Processing
Gateway
(Transit)
Bearer
(Local)
Interface
CPN
INS network
Facilities for common use
Gateway switch
64kb/s Circuit switched network
Packet switched network
High speed and broadband network
ATN
Local system
Analog interface
Y interface 64+16
I interface 64+64, MUX
I interface (High speed), Broadband
LAN

(c) MATURE STAGE

Fig.2 TRANSITION PROCESS TOWARD THE INS NETWORK

The facsimile communication network exists over the telephone network; namely it shares the lower portion of the telephone network and has a store and forward type upper portion which is physically independent of other networks.

The objective of the INS network is to integrate the above networks using digital technologies. For the time being, the INS network will be composed of a local network and the three kinds of transit networks; a 64 kb/s circuit switched network, a packet switched network, and a high speed/broad band switched network, as shown in Figure 2 (c).

The basic concept of the INS is to achieve more economical services via the INS network. The INS will provide an essential infrastructure of great social implication.

3. Transition Strategy Toward the INS Network

3.1 Transition Processes

Network digitalization will be first directed toward creating a "digital core" at the transit network level in the network hierarchy. Then switches at the local network level will be digitalized successively in such a way that at least the upward final route from switches will be digitally connected to the "digital core." The transition processes toward the INS network are shown in Figure 2 (a)-(c).

The basic concepts behind the transition toward the INS network are:
(1) Total digitalization
(2) Modularization of user interface and gateway functions.

Total digitalization of telecommunications networks has the following advantages:
(1) All types of services can be offered in a single network
(2) All types of digitalized information and signals can be easily handled in a uniform way.

The local and transit networks provide basic bearer functions which will remain unchanged for a long time in the INS network. User interface modules, providing the function defined in ISO OSI layer model, and communications processing modules may be changed as new customer equipment is installed and with unexpected introduction of a communications service. The user interface modules are separated from local switching equipment. The communications processing modules are also separated from the transit network using a gateway switching facility. With clearly defined interfaces between these modules and bearer networks, it is possible to independently improve the functions for any one module with minimum risk of affecting functions implemented in the bearer network and other modules.

One problem is how to handle existing individual networks and their services. As the existing telephone network is digitalized toward the INS, telephone service will become more and more economical, and digital data exchange of data below 64 kb/s will be provided. The facsimile communication network and the videotex communication network will be integrated automatically into the INS network as the telephone network is digitalized. With regard to the public data network service, the packet service can be combined into an INS packet service. The circuit switched network service will continue to be present for a while before being integrated into the INS.

When the INS network has in this way completely integrated individual networks, it will be possible to make use of all existing and other future useful services via one subscriber line.

3.2 Accommodation of Existing Terminals

To promote services integration, it is important to accommodate customer equipment employed in the existing individual networks.

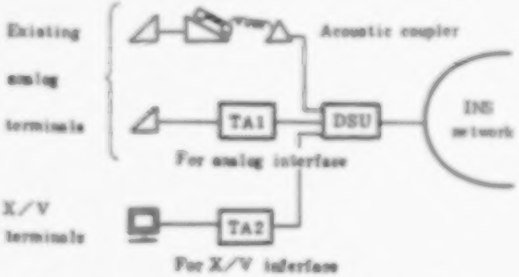


Fig. 3 ACCOMMODATION FORMS FOR EXISTING TERMINALS

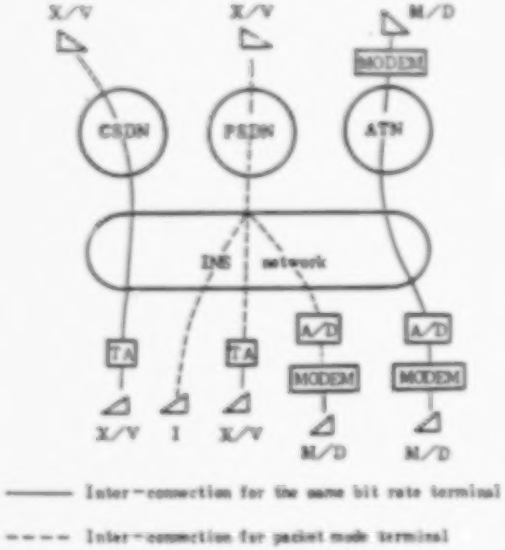

X/V
X/V
M/D
MODEM
CSDN
PSDN
ATN
INS network
TA
TA
A/D
A/D
MODEM
MODEM
X/V
I
X/V
M/D
M/D
Inter-connection for the same bit rate terminal
Inter-connection for packet mode terminal

Fig. 4 INTER-NETWORK CONNECTION

For that purpose, a terminal adapter (TA) will be developed to perform protocol conversion between the existing terminal interface and INS interface, as shown in Figure 3. This ensures two-way communication between the INS network and the existing networks. Connection plans are shown in Figure 4.

4. INS Communications Technologies

4.1 Local Network Structure

There are several subscriber accommodation methods used in digitalized local networks, depending on the information being transmitted, subscriber line signals, multiplexing number and the transmission medium.

An overview of terminal accommodation is given in Figure 5. A digital subscriber loop is constructed with circuit termination equipment installed on the subscriber and LS (Local Switch) sides by DSU (Digital Service Unit) and OCU (Office Channel Unit), respectively. The DSU has line and circuit terminating functions, and the OCU has circuit terminating, DSU accessing, and subscriber link synchronization functions.

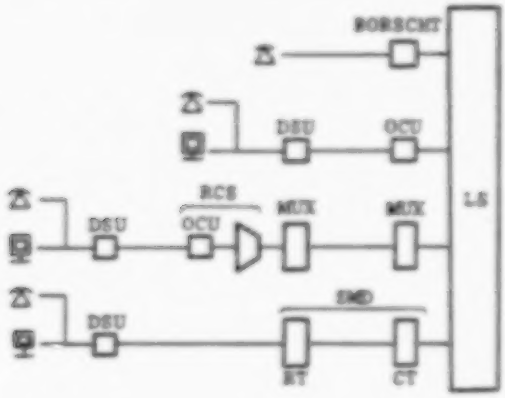
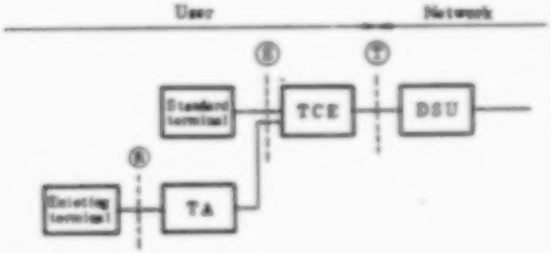


Fig.5 TERMINAL ACCOMMODATION OVERVIEW



DSU : Digital service unit
- Circuit terminating function
TCE : Terminal controlled equipment
- Circuit connection control function
TA : Terminal adapter
- Protocol and bit rate conversion function

Fig. 6 USER/NETWORK INTERFACE

To reduce the subscriber line cost, RCS (Remote Controlled Switching System) and SMD (Subscriber Multiplexed Digital Transmission System) are also applied in the local network.

4.2 Protocols

(1) User/Network Interface

The point at which user (customer) equipment and the network are separated must be defined such that:

(a) Integrated services can be offered,
(b) Fault locations can be isolated,
(c) The terminal can be easily moved,
(d) Future functions can be easily enhanced.

Considering these conditions and CCITT recommendations on international standards, the interface point T is currently being examined (see Figure 6).

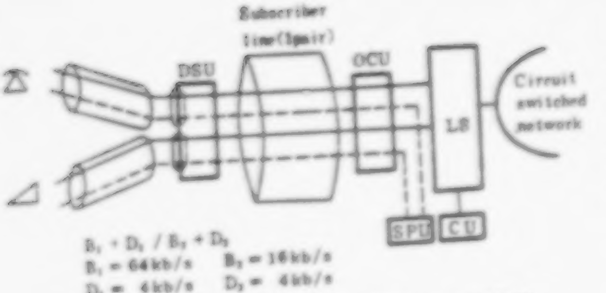
The two kinds of interfaces shown in Figure 7 with features described in Table 1 will be provided. The Y interface features 64 kb/s and 16 kb/s information channels with individual 4 kb/s signal channels. CCITT is studying a 2B + D form, called the I interface, in which a common 16 kb/s signal channel is assigned to two 64 kb/s information channels with packet switched capability. The I interface will be supported according to CCITT recommendations.

(2) Signaling System

The INS network will employ a common channel signaling system (CCS), in which a large volume of signals is transmitted to make possible a large variety of services. The signaling channel

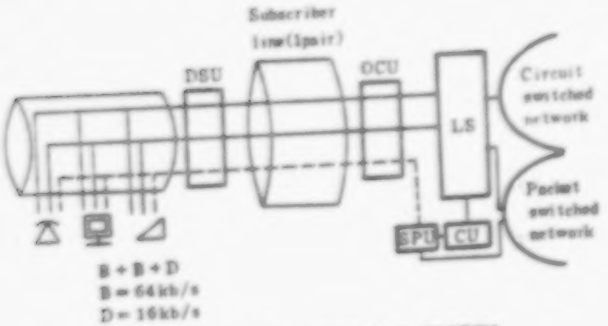
Table 1 USER/NETWORK INTERFACE FEATURES

Item	Existing analog TEL interface	Digital interface	
		Y interface	I interface
Signaling system	·In-channel signaling	·Out-channel signaling	·Out-channel signaling
Switching mode	·Circuit switched	·Circuit switched	·Circuit switched ·Packet switched
Hardware cost	Low	Low	High


Subscriber line(1pair)
DSU
OCU
LS
Circuit switched network
SPU
CU
$B_1 + D_1$ / $B_2 + D_2$
B_1 = 64kb/s
B_2 = 16kb/s
D_1 = 4kb/s
D_2 = 4kb/s

(a) CHANNEL-ASSOCIATED SIGNALING SYSTEM

(Y INTERFACE)


Subscriber line(1pair)
DSU
OCU
LS
Circuit switched network
Packet switched network
SPU
CU
B + B + D
B = 64kb/s
D = 16kb/s

(b) COMMON CHANNEL SIGNALING SYSTEM

(I INTERFACE)

SPU : Signal processing unit ——— : Information channel

CU : Control unit – – – – : Signal channel

Fig.7 USER/NETWORK INTERFACE STRUCTURE

carries packet data as well as signals. The CCS network configuration is shown in Figure 8. The CCS can be used for network control and database for new services.

(3) Numbering System

Various types of terminals, speed and protocols will be provided via one single subscriber line. To easily select destination terminals or supplementary network facilities, a proper numbering plan has to be established.

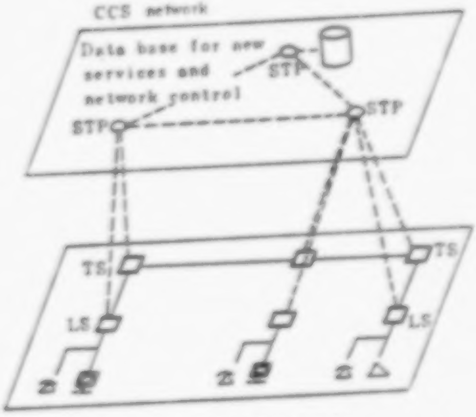
Considering compatibility with the existing telephone numbering system which most users have already mastered, the destination subscriber line numbering system is considered preferable (see Figure 9). The terminal class information (ex. media, protocol, speed) will be automatically sent from terminals. It is better to assign supplementary network facilities by manual or automatic input.

4.3 Communications Processing Functions

Enhanced communications services are required, such as storage, collection and delivery processings. The INS network will be growing as it includes the network nodes, called communications processing nodes (CPNs), which offer the following enhanced services:

(1) Facsimile communication
(2) Videotex communication
(3) Voice storage
(4) Message communication
(5) Media and protocol conversion

These CPNs are connected to a gateway switch (GS), which concentrates CPN calls from LSs and converse between the bearer network and CPNs (see Figure 10). Using GS facilities, it is possible to improve the CPN functions without affecting functions implemented in the bearer network.


CCS network
Data base for new services and network control
STP
STP
STP
TS
TS
LS
LS

CCS : Common channel signaling

STP : Signal transfer point

Fig.8 COMMON CHANNEL SIGNALING NETWORK CONFIGURATION

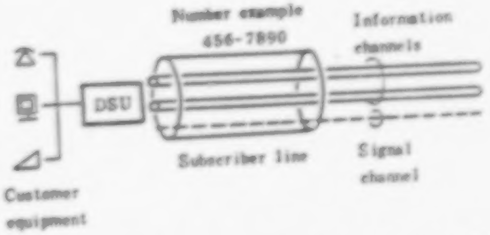

Number example
456-7890
Information channels
DSU
Subscriber line
Signal channel
Customer equipment

Fig.9 EXAMPLE OF NUMBER ASSIGNED TO A SINGLE SUBSCRIBER LINE

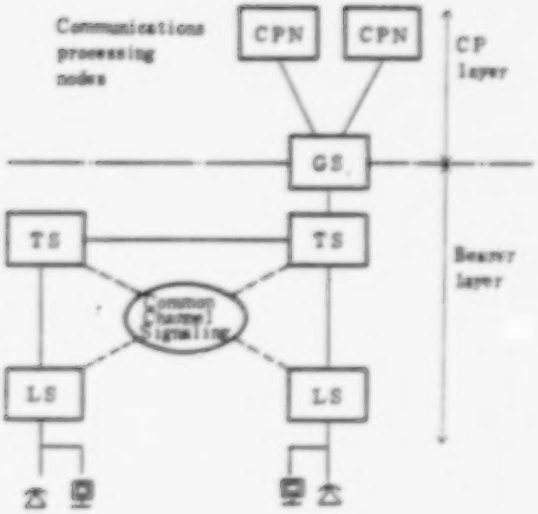


Fig.10 GATEWAY SWITCH (GS)

5. Conclusion

The advanced information society will have a communications network to handle various kinds of information, such as voice, data, text and video. Rapid progress in digital technology has enabled the construction of more economic and efficient digital networks. The concept of the INS includes high quality, high speed and inexpensive transmission services in the total digitalized network.

This paper described the transition process toward the INS network, and outlined the local network structure, protocols and communications processing functions as the key technologies for constructing the INS world.

The technologies which enhance the efficient development of software, and the optimum integration of the 64 kb/s network and the high speed/broad band network remain for further studies.

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(4) H. Kimura, A. Niwa and S. Suzuki, "Basic Scheme for the INS Network", Review of the ECL, Vol.33, No.5, pp.751-756, 1985.

(5) M. Fournier, "What Is A Digital World ?", PTC '85, pp.4-10.

ISDN CUSTOMER ACCESS SYSTEM

- IMPLEMENTATION AND EVALUATION

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Abstract

This paper describes the implementation and evaluation of the ISDN experimental system based on the CCITT recommended user/network interface. The system supports 2B+D basic access interface for various terminals and has interworking capabilities with public switched telephone network.

1. Introduction

Increasing demands for telecommunication network digitalization and integration have brought up discussions of development of the Integrated Services Digital Network (ISDN), and many ISDN standardization activities have resulted in issuing 1984 CCITT I-series recommendations.
The ISDN is a netwrok that offers to its customers digital end-to-end connectivity as well as with various kinds of simultaneous voice and data services via a unique user-network interface. The user-network interface will therefore play a key role in making the ISDN feasible.
The CCITT I-series recommendations are the paper work and several some key items have been left as further studies which require continuing efforts including laboratory and field evaluations. The user-network interface is not an exception, and a lot of field experiments are required not only to supplement the recommendations but also to let customers know how the ISDN works and to get such information as service requirements and market potentials from the customers.

To meet those demands, NEC has developed an ISDN customer access system which accommodates so-called "asic Access (2B+D) lines and demonstrates its capabilities in the ISDN to customers.
This ISDN customer access system can be operated as an ISDN adjunct system. It maximizes the use of the existing switching system, and is expected to be an answer to both netwrok operators and end users who wish to introduce the ISDN at a minimum start-up cost and with minimum modifications to the existing network.

2. Network digitalization and ISDN

As the telephone network goes digital, the ISDN becomes easier to be introduced. The ISDN can be phased in from the telephone network and offers integrated communication services through the digital customer access lines. Its interface to individual customers is standardized to meet their multi-purpose demands.
A standard ISDN network is composed of:

1) Customer premises equipment
2) Customer access system
3) Digital switching & network transport
4) Communication & information processing equipment

The customer premises equipment includes all kinds of terminals such as standard telephone sets, integrated voice and data terminals handling voice-data and image communications, PABX, LAN, and terminal adapters.
The customer access system provides interfaces for connections between the digital switching system and subscriber equipment.
The 2B+D basic access and nB+D primary rate access are involved in the CCITT recommendations based on which the digital subscriber line network will be organized.
The digital switching and network transport provide both circuit-switched and packet-switched connections. Communication processing can be represented by the protocol and media translations. Information processing includes data base and data processing.
Still more ISDN-related subjects remain to be discussed, and every member nation is expected to proceed with its field application after reviewing the secondary I-series recommendations that will be adopted in the coming CCITT meeting. It is also anticipated in parallel with the ISDN tests that telecommunication

network digitalization will be advanced in many nations at a considerably fast pace.
The ISDN development is expected to grow mostly in the following three phases:

1st Phase: Initially the digital subscriber access system that allows simultaneous voice, data and image calls and provides, an interconnection function, which links the ISDN with other existing networks, will be introduced with the common line signaling system indispensable to the ISDN operation.

2nd Phase: In this phase, ISDN services will be broadened, including communication processing service functions such as high-speed switching at transfer rate of a few mega bits, the protocol, and media translation.

3rd Phase: Higher-speed communication services such as high-quality color moving image communication will be introduced.

3. ISDN Customer Access System

3.1 ISDN Architecture

The digital switching system fills an important role in providing ISDN services on the network level. Various terminals as shown in Fig. 3.1 use B-channels to carry communication information and D-channels to convey the signal and packet information. Each terminal is then allowed to receive circuit and packet-switching services via one and the same interface.
With point-to-multipoint configuration, any ISDN terminal and/or conventional terminal with an appropriate terminal adapter (TA) can easily be connected to the 'S'-interface passive bus and can gain access to the ISDN.

3.2 ISDN Customer Access System

NEC has been developing the ISDN Switching System and associating it with customer premises equipment complying with CCITT recommendations.
A part of the system had first demonstrated its capabilities at Asia Telecom 85 held in Singapore in May 1985.
The North American version of ISDN customer access system has been installed in September 1985, and is now under field evaluation as an ISDN adjunct. Fig. 3.2 depicts this ISDN customer access system, which consists of the following functional blocks:

(1) Digital Line Module (DLM)
(2) Digital Transmission Interface Module (DTIM)
(3) Network Terminations (NTs)
(4) Integrated Services Terminals (ISTs)
(5) Terminal Adapters (TAs)
(6) Conventional terminals including standard telephone sets, facimiles and personal computers

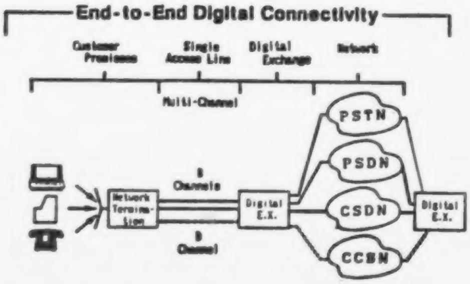

End-to-End Digital Connectivity
Customer Premises
Single Access Line
Digital Exchange
Network
Multi-Channel
B Channels
D Channel
Network Termination
Digital E.X.
PSTN
PSDN
CSDN
CCSN
Digital E.X.

Fig 3.1 ISDN Architecture

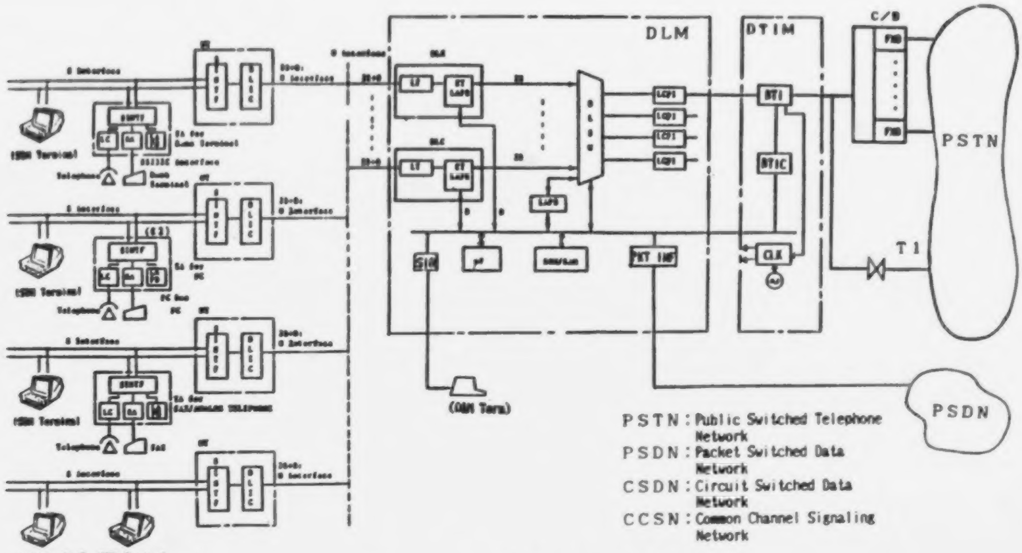

DLM
DTIM
C/D
PSTN
T1
PSDN
S Interface
ISDN Terminal
Telephone
Data Terminal
RS232C Interface
U Interface
NT
DLC
LT
LAPD
DTI
DTIC
CLK
PKT INF
(O&M Term)
PSTN : Public Switched Telephone Network
PSDN : Packet Switched Data Network
CSDN : Circuit Switched Data Network
CCSN : Common Channel Signaling Network

Fig 3. 2 System Configuration

4. Design Considerations for ISDN Customer Access System

The ISDN Customer Access System requires some of the state-of-the-art techniques, such as two-wire digital transmission, point-to-multipoint passive bus operation (with the S-interface), newly defined D-channel protocol (LAP-D), and highly intelligent D-channel signaling terminals with less power consumption. Therefore a key to the ISDN realization is that major functional elements are available as LSIs and/or VLSIs.
Those functional elemetns include:

(1) Digital Line Interface Circuit (DLIC) for two-wire digital transmission over existing subscriber loop plants
(2) D-channel Protocol Handler (DH) supporting LAP-D specified in CCITT recommendations
(3) S-interface Cotroller (SINF) through which the terminal equipment can be connected to the standardized passive bus.
(4) Rate Adapter (RA) which converts a low data speed of the terminal to the B-channel bit rate (64 Kbps)
(5) Low-power single-chip microprocessor which implements D-channel signaling (layer 3) and man-machine interface

Fig. 4.1 shows the positions of these elements used in the ISDN user-network interface.

4.1 Digital Line Interface Circuit (DLIC)

The two-wire digital transmission technique is one of the techniques that have been studied hard from the earlier stage of ISDN development, since it is an important function which provides the 2B+D Basic Access capability over existing subscriber loops. As is well known, two methods below have been the candidates.

(1) Echo Canceller Method
(2) Ping-pong Method

A lot of discussions have been made of advantages and disadvantages of these methods and, in recent days, many network operators have began to choose Echo Canceller.
The DLIC is a digital signal transceiver utilizing one of these transmission methods.
The prototype ISDN Customer Access System described in this paper uses the Ping-pong Method DLIC.

4.2 D-channel Protocol Handler (DH)

To support point-to-multipoint operation, LAP-D has been specified in the CCITT recommendations. LAP-D is a modified version of LAP-B, but it cannot be supported using existing LAP-B LSIs. Thus, to get a low-cost, high-performance D-channel Protocol Handler (DH) will be a major concern for both the switching system and terminals.
There seems to be two approaches to the DH realization: design of a VLSI having all the functions of LAP-D, and use of standard serial I/O devices under control of the microprocessor.
Table 4.1 compares these apoproaches. Our ISDN Customer Access System is aiming at the VLSI approach, since we believe that the layer 2 functions are to be realized as hardware rather than software, and this reduces not only hardware itself but also the system development cost significantly. In the prototype ISDN Customer Access System, a three-chip set of gate array LSIs has been used for the DH.
This gate array version of DH has been designed as a prototype of the single-chip DH and also has been used as a debug set of the firmware which is to be mounted in the single-chip DH as shown in Fig. 4.2.

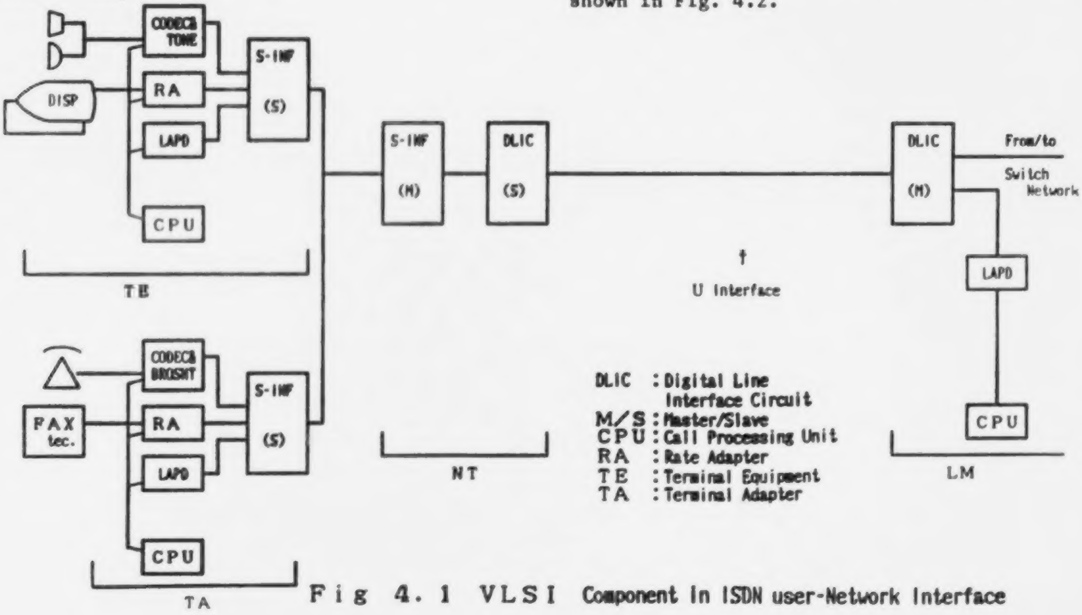
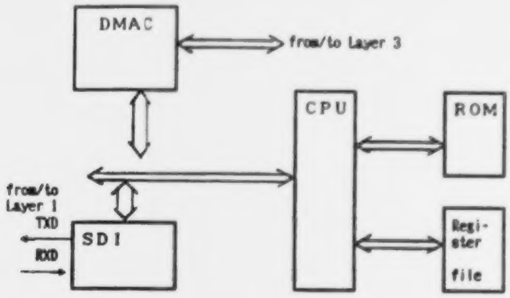


Fig 4.1 VLSI Component In ISDN user-Network Interface

Table 4.1 Comparison of two different Hardware Configurations

Item	Line concentration method	Per-line method (Individual Channel Control System)
LSI Feasibility	×	○
Firmware	△	○
Application to ISDN terminals	△	◎
Economy (for smaller number of line involved)	△	○



CPU : Central Proccessor Unit
SDI : Serial Data Interface
DMAC : Direct Memory Access Controller

Fig. 4. 2 Configuration of LAPD handler

4.3 S-Interface Controller (SINF)

The S-Interface is defined as a form of the ISDN cabling in the subscriber's premises, and it can simultaneously access two 64-Kbps channels and one 16-Kbps channel. It is a 192-Kbps 4-wire interface involving a framing bit and an echo bit in the frame configuration.

The point-to-multipoint connection over the S-interface is possible as shown in Fig. 4.3.

Since the frame structures of up and down links are not symmetrical, SINF functions required for Network Termination (NT) and conventional termianls are much different. The developed SINF LSI, however is mode selectable master or slave such that the same LSI can be applied to both NT and any terminals or terminal adapters.

4.4 Rate Adapter (RA)

The Rate Adapter (RA) provides a function that converts a relatively low data rate of the terminal into the B-channel rate (64-Kbps), and vice versa. This function is indispensable for data services since most of the data services are believed to be supported with the use of existing low-speed terminals.

Every terminal equipment or terminal adapter is equipped with an RA LSI which supports CCITT recommendations I.461 and I.463.

When designing the RA LSI, it has been a perplexing problem that, though I-series recommendations deal only with synchronous mode of operation, most of the existing terminals are of asynchrous mode.

The design of the multi-mode RA is answer to the above problem, and the following operation modes are provided to increase system flexibility.

This mode selection can be performed by the compatibility check hased on call by call basis.

Table 4.2 Rate Adapter

Mode	Description	Note
Mode 1	CCITT I461/463 mode	Sync only
Mode 2	6+2 Envelope operation mode	Sync/Async
Mode 3	CCITT I463 with V.22 async/sync conversion	Async

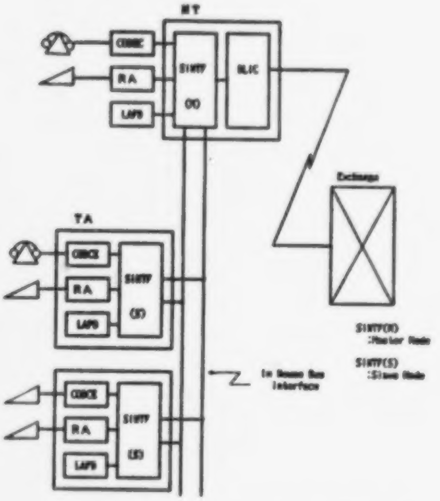


Fig 4. 3 S Interface Configuration

5. Field Evaluation System

Quite many services will be expected thanks to the introduction of 2B+D digital customer access technology. Before receiving ISDN commercial services, it is very important for both operating companies and users to assess and understand these expected service capabilites. From this viewpoint, we have developed the field evaluated digital customer access prototype system. This system is being, and also used for ISDN services demonstration to both operating companies and end users. It can be upgraded to an ISDN remote system with the primary rate access interface in the near future.

As shown in Fig 5.1, the prototype digital customer access system is connected to an existing telephone switching system as an adjunct unit.
Signal conversion between ISDN D-channel signal and existing telephone signal is implemented at the adjunct unit.
Telephone call services are handled at the host switch, so that most of the existing telephone services are available for ISDN customers.
Data call services are handled at the adjundt unit for both circuit-switched and packet-switched calls.
Integrated voice and data service can be implemented in the existing network. It can be evalutated and demonstrated easily using the prototype digital customer access system.

Table 5.1, shows the specifications of the prototype digital customer access system.

Table 5.1 Field Evaluation System

Line Interfaces	- Subscriber line U interface : 144kb/s 2B+D (TCM) S interface : CCITT I430 - CO Interface line T1 Span Line (23B+D) Conventional Telephone Line (FXO)
Srevice	- Circuit-Switched Telephone Call - Circuit-Switched Data Call - Packet-Switched Data Call - Calling Number Identification - Incoming Call barred - Outgoing Call barred
Terminals	- Network Termination for passive bus - Integrated Voise & Data Terminal - Terminal Adapter for conventional telephone interface teminal - Terminal Adapter for conventional RS232C interface terminal

6. Conclusion

In order to form an infrastructure of the current information society the digitalization of existing telecommunication networks and ISDN construction are going on in a rapid pace. It is however defficult to predict what kind of services would emerge in the future. In any case the ISDN services will be evaluated by its field test at first and more efforts shall be done to advance and broaden its services.
This paper introduce the digital customer access technologies and its field evaluation system. The customer access technologies play an important role in ISDN telecommunication network. Further development activities should be done to meet the customer needs.

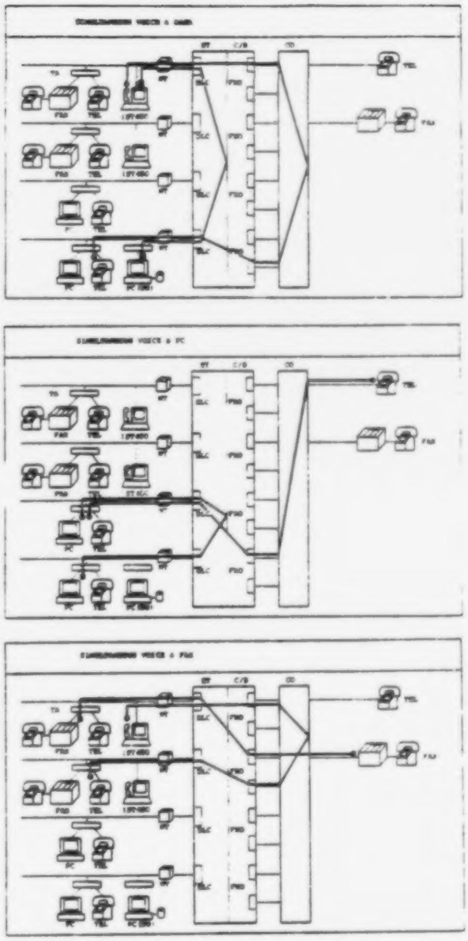


Fig 5.1 Example of call connection in prototype trial system

Acknowledgement

The authors gratefully acknowledge the encouragement and guidance given by Mr. A Kitamura, general manager, and A. Minato, manager, Integrated Switching Development Division, and also acknowledge the development co-operation to other participants.

Reference:

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DIGITALISATION OF THE COMMUNICATION NETWORK IN INDIA

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Abstract

The mid-sixties saw a succession of major technological advances taking place and thus making significant effects in the telephone network all over the world with discernible advantages, these technological changes in the form of digital techniques have caught on creating a demand for better and more versatile telecommunications through what we now call the digital system. In India, we have thus taken a far reaching step towards modernising the telephone system and network. But the evaluation towards an integrated digital network will have considerable effect on the overall architecture of the network and has already created a complex traditional task. It is also impossible to change the network to digital all at one time and it is necessary to study how digital and analog sub-components can fit together. At the same time, it will be necessary to develop strategies for the evolutionary process to an integrated digital network. The recent electronics policy announced in Parliament of India states: "The Government has decided that there is a need to accelerate the use of electronics equipment such as communication equipment including mass communication computerised control equipment, data communication and data processing equipment. A large country such as ours cannot afford to continue to import such equipment. As such, it is proposed to set a target of local production of R·100 billion by the year 1989-90." In this paper, we see that with the introduction of digital switching, the future prospects of an integrated digital network is closer to reality. At the turn of the century, IDN will be very much with us, excepting perhaps the subscribers instrument and subscribers loops. The establishment of protocol for digital transmission on individual lines on a standard basis will further enable transmission of either voice or data and the ultimate goal is an Integrated Service Digital Network.

1. Present Network

1.1 The transmission plan of the Indian telecommunication network stipulates a hierarchy comprising of - in a descending form -

Main Centres	(Four large metro cities)
Primary Centres	(State Capitals)
Secondary Centres	(Revenue district headquarters)
Tertiary Centres	
Terminal Exchanges	

1.2 In development and evolution of this hierarchial network, certain objectives were laid:

- to interconnect main centres by at least two independent and direct media;
- to interconnect primary centres to main centres by two independent and direct media and to interconnect transverse routes also by two independent media;
- to connect secondary centres to primary centres by reliable media like coaxial or microwave systems;
- to incorporate requirements of user departments for vehicle channels for television, data transmission, facsimile, telemetry services, etc., wherein the network conforms to CCITT standards as far as practicable;
- to provide inter-exchange networks using RCM systems operating on underground cables or on coaxial or microwave systems.

1.3 The extension of National Subscriber Dialing in the network influenced the transmission plan. In fact, with advent of NSD, there was a close interaction in the transmission routing and switching plans. The choice of the type of switching (4-wire or 2-wire) at truck exchanges was also one of the important criteria in fast the growth of NSD networks.

1.4 It is important to note here the pattern of traffic in the Indian network. The analysis indicates that 80% of calls terminate within 500 Kms. Also:

- 60% of calls originate and terminate within the same primary area;
- 20% of calls are between primary areas of the same main area;
- 15% of calls are between main areas but originating and terminating at main centres;
- 5% of calls are other calls between main areas;

2. Digital Technology

2.1 To simplify matters, with digital technology, voice signals from a telephone can be coded electronically in the form of binary "on" or "off" - pulses on varying sequences. After transmission through a network, these codes can be easily and accurately converted back into original voice signals. The advantage derived is that all signals whether voice, data or image are handled in the same way as bits of identical characteristics. Thus we can answer the question "why digital?" by these words: "performance, flexibility, and cost."

2.2 Digital technology offers a high quality of performance, with the line transmission performance becoming independent of route length. The use of regenerative repeaters virtually eliminates build-up of noise and distortion in the signals. The major degradation in signal is at the terminals when the analogue to digital (a/d) and digital to analogue (d/a) conversions and associated coding operations are done.

2.3 The flexibility mainly arises due to the feasibility of sending digital voice, data and video. Different signals such as these with different bit rates (i.e. band widths) can be efficiently combined. Such intermixing of signals does not have the problems of interaction between signals transmitted and of overload as experience in analogue transmission. With different services, only the terminal equipment will change. In general, digital systems can transmit more data on equipment voice circuits than on analogue circuits.

2.4 The digital technology gained the maximum progress with the rapid development of devices technology. Solid state devices, hybrid circuitry, thin and thick films, families of high speed logic and medium and large scale integrated circuits have allowed the complex process of digital encoding, multiplexing and transmission to be implemented at ever increasing bit rates, with greater economies and extremely high reliability.

3. Digital Techniques

3.1 What is a digital switch? A digital switch allows signals to be handled without conversion to analog which is necessary for current types of switching machines, such as the cross bar. A digital switch consists essentially of a solid state switching network -- a collection of integrated digital circuits -- controlled by a computer. It routes digitally encoded signals by merely moving bits of information from an incoming source to an outgoing transmission line. On the same connection, it is necessary to delay the incoming information for a few micro seconds until a free time slot is available on the out-going line.

3.2 The digital transmission system was developed in early 1960. Their first application was to meet the need for exchange trunk facilities in large metropolitan areas. The PCM (Pulse Code Modulated) systems lent themselves well to the performance, operational and economic requirements of inter-exchange trunks in the range of 24 to 80 kilometers. Two basic standards developed in PCM Systems. The original basic system provided 24 channels with a line bit rate of 1544 K bits/sec. This has been largely adopted by USA, Canada and Japan. The later version adopted in Europe, South America, Australia and now in India provided 30 channels with a line bit rate of 2048 K bits/sec.

3.3 The demand for a large number of junctions between exchanges and the technological capabilities has brought about the development of a hierarchy system. Considering the system of interest to India, the features are briefly given below:

Hierarchy Level	Feature
1. Bit Rate in K bits	2048
No. of telephone channels	30
Bit rate per telephone channel K b/s	68027
2. Bit rate in K b/s	8448
No. of telephone channels	120
Bit rate per telephone channel in K b/s	70.4
3. Bit rate in K b/s	34368
No. of telephone channels	480
Bit rate per telephone channel in K b/s	71.58
4. Bit rate in K b/s	139264
No. of telephone channels	1920
Bit rate per telephone channel in K b/s	72.53

5. A new hierarchy is already under development to provide yet a higher capacity of 7680 channels at a bit rate of 565 M Bits.

3.4 The application of digital transmission techniques to different media, such as coaxial cables, optical fibre cables, microwave systems has been significant. Starting from an application for very short haul applications, digital transmission system for long haul applications, telephone administrators are now increasingly using digital microwave systems to provide alternate routing for gaining better reliability and flexibility.

4. Objectives

4.1 The evolution towards an integrated digital network will have considerable effect on the overall architecture of the network and has already created a complex transitional task. It is also impossible to change the network to digital at one time and it is necessary thus to study how digital and analog subcomponents can fit together. At the same time, it would be necessary to develop strategies for the evolutionary process to an integrated digital network.

4.2 During the Sixth Five Year Plan, recognizing the advantages of digital switching, an early decision had been taken to provide only digital trunk automatic exchange. With the major decision to go for total digital switching, it has now become necessary to plan objectives for conversion to digital networks.

The tentative plan for the Seventh Five Year Plan accordingly lays down progressive digitalization of at least 60% to 80% or more of the network by the year 2000. A Master Plan is also being formulated separately.

4.3 In the meanwhile, heavy induction of digital switching has already been programmed. A brief idea of this is obtained from the following.

4.3.1 Allotment of the first 200,000 lines of digital local switching equipment.

Bombay	60,000
Calcutta	32,000
Madras	12,000
Kanpur	10,000
Amhedabad	10,000
Delhi	49,000
Hyderabad	10,000
Pathankot	3,000
Sriganganagar	3,000

4.3.2 Allotment of first 22,000 lines of digital trunk switching equipment:

Pune	3,000
Surat	1,000
Rajkot	2,000
Cuttack	1,000
Agra	2,000
Raipur	1,000
Vishakapatnam	1,000
Ludhiana	1,000
Tiruchi	2,000
Bhopal	1,000
Jalandhar	2,000
Ranchi	1,000
Varanasi	1,000
Jodhpur	1,000
Lucknow	1,000
Bangalore	1,000

4.3.3 An additional 200,000 lines of digital local switching equipment is expected to be allotted shortly. Similarly, digital transmission links are being proposed for junctions in metro networks. Certain long distance routes are also being considered for being provided with digital systems.

4.4 For local exchange equipment, it is proposed that in metro and major cities and state capitals, all new local exchanges may be digital only. This includes digital tandems also. All new local exchanges anywhere, if parented to digital trunk automatic exchange, will also be digital.

4.5 All new trunk automatic exchanges will be digital. Expansion of truck automatic exchanges at primary centres will be by digital equipment. However, in main switching centres, expansion of trunk automatic exchanges may be either by SPC analogue equipment or digital equipment. No further subscriber trunk dialing routes will be opened using Strowger equipment. Similarly, no MLOD centres will be opened with Strowger equipment.

4.6 In the case of telex centres, all new centres will be of digital type only. Even for expansion of existing Strowger-type telex, digital equipment will be provided replacing entire Strowger telex.

4.7 The 16 digital trunk automatic exchanges planned in the current phase are proposed to be interconnected by digital transmission media. The transmission link connecting a digital local exchange to a trunk automatic exchange is proposed to be on digital media. All inter-trunk automatic exchange circuits where one end is digital is proposed to be on a digital medium. Similar is the case for junctions interconnecting exchanges.

4.8 On the rural network, plans are drawn up for integrated switching and transmission. These areas are being planned to be connected by digital transmission links to digital secondary trunk automatic exchanges.

5. Strategies Available

5.1 With a relatively long service life obtained for both switching and transmission equipment, the transitional period may extend say 15 to 20 years. Also, the conversion costs will be heavy in the initial phase of transmission, with full benefits occurring towards the end of the transitional period. The interworking costs may also be heavier in the initial phase. The geographical dispensation of digital equipment will have, therefore, to be harmonized.

5.2 Due to higher initial costs and marginal costs for expansion and increased size of transmission building blocks (30 channels in PCM compared to 12 channel in analogue) it is economical to connect traffic to smaller number of large switching modes. In digital networks, therefore, fewer larger-usage routes and more multi-link routings will emerge among fewer large capacity switching modes.

5.3 During the conversion period, routing among digital exchanges would use new network, which analogue network will be used for existing exchanges. Even though the hierarchy of switching centres may not be changed, the number of primary centres, secondary centres and tertiary centres will close co-operation and co-ordination of switching and transmission planning.

5.4 There are generally two strategies for evolution to digital, viz., overlay and integrated. The overlay network is based on the principle of designing a new network as a separate entity, independent of existing one. The connection between the two networks is by means of one or more digital transit centres that act as gateways. The analogue network is removed at the end of its life and their function taken over by digital exchange. The transit centres will be removed. Thus, overlay network would permit setting up of digital network without constraints, minimising the need for analogue/digital conversion. However, it has to be realised that this scheme would also require digital transit centres to grow reaching maximum capacity when both networks have equal number of subscribers. The scheme will also require a minimum of two transit centres to avoid security problems. There will be additional problems of limitations in use of external plant.

5.5 With the integrated network strategy, the elaborate and complex approach of overlay network does not arise. The only disadvantage will arise due to need for extensive use of A to D converters. Integrated network strategy is attractive where the new digital network has a close resemblance to that of the existing analogue network.

5.6 In an urban network with multi-exchange set up, it is advantageous to adopt overlay strategy, with one or more digital transit centres connecting the overlay network with the existing one. Thus, the call path in any choice route would be ensured to be mostly a digital network with late entry into the analogue network. It will also be beneficial to use CCITT R2 signalling which is capable of working on analogue side in a modified form.

5.7 The secondary area is an ideal choice for implementing IDN strategy in concentrated form. Digital switches capable of operation as integrated local cum tandem switch at secondary centres are already available. Digital transmission systems both in radio and in cable versions capable of being sub-equipped have been developed.

6.0 Future Tasks

6.1 The digitalisation of the telecommunication network will not be complete for a long time, not merely for the reasons of existence of analogue network but also for several other reasons. Total digitalisation would mean digitalisation of voice or signals at subscribers' premises carried digitally through subscriber loop-lines to digital switching centres.

6.2 The eventual extension of A/D conversion to subscriber instrument will be governed by the line interface requirements, colloquially known as "BORSCHT". Borscht is an acronym for:

Battery (to feed the analog transmitter)
Over voltage protection
Ringing
Supervision
Digital Coding
Hybrid to separate directions of transmission
(required for most digital systems)
Test access to reach both in office and
outside plant.

The requirements of BORSCHT have been specifically designed and built into an interface in some of the designs.

6.3 Subscriber's loops on a concentrator basis have also come in vogue. PCM systems with sub-systems of 10 channel capacity are now developed, which can provide considerable economies to an already economic digital network. With the development of LSI for application as codes on a single channel basis, the digital subloop will become soon a common practice.

6.4 New signalling schemes are also under development. CCITT has been working on a new standard No. 7. This scheme which is essentially a common channel signalling plan, will eventually replace all earlier schemes including CCITT R2 Plan.

7. Conclusion

7.1 With the introduction of digital switching, the future prospects of an integrated digital network is closer to reality. At the turn of the century, IDN will be very much with us, excepting for subscriber's instrument and subscriber loops. The establishment of protocols for digital transmission on individual lines on a standard basis will further enable transmission of either voice or data.

7.2 This will emerge the ISDN - Integrated Service Digital Network. For all of us in India, this is an exciting possibility where, in the present time frame, we have been restricted to telephone, telegraph, telex, and to a limited extend data on a separate network. P&T proposes through its objectives of IDN so all reach this ultimate goal of ISDN.

New Versatile Data Communication Service And The Development Of PACNET

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1. ABSTRACT

PACNET, a public packet switched data network was established in Taiwan, The Republic of China in Oct. 1985. This paper briefly reviews the present status of the network and describes the problems which exist between PACNET and chinese character code host/terminal, and the strategies which will be used to solve them. A description also given for the planned supporting role of the PACNET of new public service such as integrated network service (INS) among PACNET, circuit switched network and telex network, teletex service and message handling system.

2. THE PACNET NETWORK

2.1 NETWORK CONFIGURATION

There are three switching nodes located at Taipei, Taichung and Kaohsiung, respectively. These three nodes are mutually connected with trunk line of full-duplex 9.6/56 kbps (FIG 1). The total trunk capacity is given as follow:

Taipei-Kaohsiung	56kbps x 3
Taipei-Taichung	56kbps x 2
Taichung-Kaohsiung	9.6kbps x 4

The Network Control Center (NCC) is located at Taipei. To ensure uninterrupted service, the central units of the NCC and the peripheral devices are provided in duplication, and the system operates on hot-standby basis. Each NCC computer is connected to the switching node at Taipei with two full-duplex 9.6 kbps data links. An international gateway for connecting overseas public packet switched data network via international leased circuit was provided at Taipei node. These international gateway facilities have the capability to establish international switched virtual calls to the DTEs in many other countries.

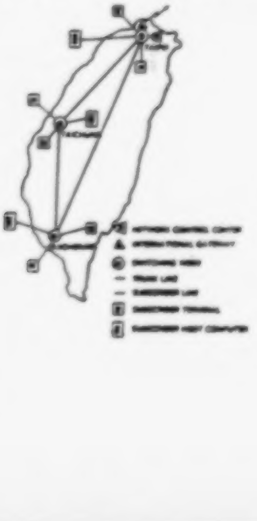

FIG 1.

2.2 PACKET SWITCHING EXCHANGE (PSX)

PSX of each switching node of PACNET utilizes a state-of-the-art hardware architecture, they are designed by SESA (Societe d'Etudes des System d'Automation) France, and manufactured by BTMC (Bell Telephone Manufacture Company) Belgium. PSX is organized around a powerful and duplicated exchange highways: The Packet Bus is a dual parallel bus operating at 10 Mbps in block-mode on which forty median-coupled hardware module called DATEM can be connected (FIG 2); Its operation is similar to a local area network.

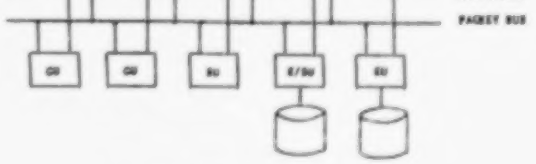

FIG 2. PSX STRUCTURE

2.3 DATEM HARDWARE STRUCTURE

The Datem structure is organized around an internal bus to which are connected (FIG 3):

-A power supply.
-A central processor based on a ZILOG Z80 microprocessor.
-One or more (3 max) memory boards containing 128 or 256 k bytes of RAM

memory.
-A high speed bus coupler (HSBC).
-One or two line controllers with their own microprocessor and local memory. Three types of line controller are available, the LC2H, LC8M and LC16A. LC2H adapter 2 high speed synchronous HDLC ports, LC8M adapter 8 synchronous HDLC ports and LC16A adapter 16 asynchronous ports. The number of ports at each node is specified in Table 1.
-A winchester disk interface.

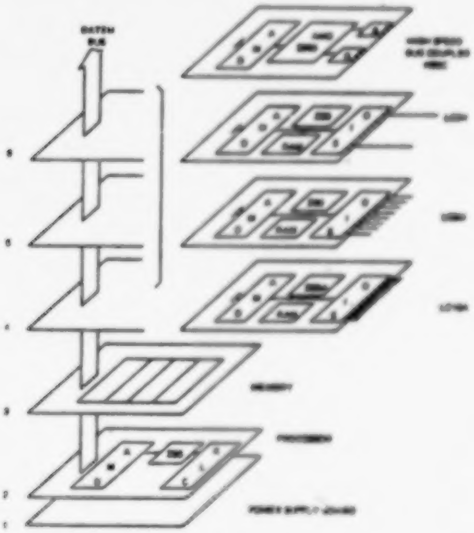
DATEM BUS
MEMORY
POWER SUPPLY BOARD

FIG 3. DATEM STRUCTURE

TABLE 1.

Node / Mode	TAIPEI	TAICHUNG	KAOHSIUNG
Packet Mode	216	40	80
Character Mode	256	48	80

2.4 NETWORK CONTROL CENTER

Network Control Center (NCC) coordinates the overall operation of PACNET. The principle tasks of the Network Control Center are remote control and monitoring of the network modules, as well as managing all the programs and relevant to the network and nodes. The NCC is equipped with 2 Honeywell supper minicomputer DPS 6/92 and other peripheral devices. Information is exchanged with the network modules via an X.25 interface. FIG 4 shows the functional architecture of the Network Control Center.

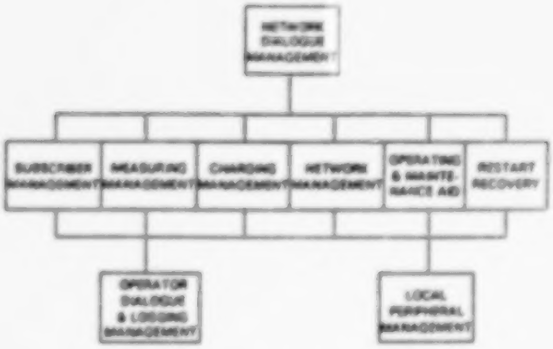
NETWORK DIALOGUE MANAGEMENT
SUBSCRIBER MANAGEMENT
MEASURING MANAGEMENT
CHARGING MANAGEMENT
NETWORK MANAGEMENT
OPERATING & MAINTENANCE AID
RESTART RECOVERY
OPERATOR DIALOGUE & LOGGING MANAGEMENT
LOCAL PERIPHERAL MANAGEMENT

FIG 4. NETWORK CONTROL CENTER FUNCTIONAL ARCHITECTURE

2.5 INTERNATIONAL GATEWAY

The international access of PACNET to packet switched network in other country is available via ITT UDTS 2. Connecting to packet switched networks in North America (eq. Tymnet, Telenet, Uninet, Marknet, ...) have been available since Oct. 1984. Access to packet switched network in Singapore, Hongkong, Japan and France also were available in Aug. 1985. That also will be available to access to U.K., Netherland, Sweden and Belgium in the third quarter of 1985. Initially, an X.75 satellite link was used for this international access, in third quarter of 1985 a second X.75 link via submarine cable would be implemented and the link of international gateway would be operated in mutual back up mode.

2.6 INTERNAL ROUTING STRATEGY OF PACNET

Routing in PACNET is distributed and adaptive. Distributed means there is no master routing center which collects and distributes the routing information, but every node in the network has the responsibility for routing to the next node in order to reach the destination.

Adaptive means, the routing adapts itself dynamically to every modification in the network such as going in service or out of service of nodes and links and the availability or non-availability of resources in Datems. Further it is not required for a node to know the topology of the network.

3. SUBSCRIBER ACCESS TO PACNET

3.1 PROTOCOL SUPPORTED BY PACNET

PACNET currently supports two main catagories of Data Terminal Equipment (DTE) as specify in Table 2. Other protocols such as IBM-BSC, SDLC are planning to be supported in the near future.

TABLE 2. TERMINAL TYPE SUPPORTED BY PACNET P: PROVIDE
-: NOT PROVIDE

DTE Type	Speed(bps)	Transmission type		Network access	
		Synchronous	Asynchronous	Leased circuit	PSTN
Packet Mode	2400	P	-	P	-
	4800	P	-	P	-
	9600	P	-	P	-
Character Mode	300	-	P	P	P
	1200	-	P	P	P

1. Synchronous DTEs operating in packet mode in according with CCITT Recommendation X.25 and at data rates of 2400, 4800 and 9600 bps.

2. Asynchronous character mode terminals which interface to the network in accordance with CCITT Recommendation X.28 and communicate with X.25 DTEs via the network in accordance with Recommendation X. 3 and X.29, and operating at data rates of 300 and 1200 bps.

3.2 ACCESS METHOD

Depending on the type and operating speed of the DTE, access to the network is provided via leased circuit or via dial-up through public switched telephone network (PSTN).

3.3 THE PROBLEMS OF CHINESE CHARACTER CODE HOST/TERMINAL ACCESS PACNET

Data processing business is making increasing use of electronic information and text communications. The functions of Chinese character code host/terminal required by the business now is not only for simple data processing but also for Chinese text communications. There are many kinds of Chinese character code host /terminal in the information market of The Republic of China Each kind of Chinese character code host/terminal has it own Chinese coding algorithm and I/O access method. Different Chinese coding algorithm use different information interexchange code for storage and transmission. There are three major Chinese information interexchange codes: Chinese code for data communication, CCDC, Chinese character code for information interexchange, CCCII, and Chinese ideographic standard code for information interchange,CISCII.

In spite of the coding algorithm, we can divide them into two catagories: 7 bit system (CCDC and CCCII) and 8 bit system (CISCII). In 7 bit system, it needs one leading code followed two or three bytes of data to represent one Chinese character code. The leading code is used for system to distinguish Chinese code from ASCII code. In 8 bit system, two bytes are used to hold one Chinese character code, with the highest bit set on both bytes to distinguish Chinese code from ASCII code.

There is no problem with the connection between PACNET and each kind of Chinese character code (7 bit system or 8 bit system) host/terminal using X.25, because X.25 interface of PACNET is octect orient and fully transparent to all coding algorithm. There is also no problem with 7 bit Chinese character code host/ terminal using X.28 to connect to PACNET, because 7 bit Chinese code system looks like an ASCII code start/stop subscriber for PACNET. But there are some problems with 8 bit Chinese character code host/ terminal using X.28 to connect to the PACNET.

CCITT X.28 specifies the dialogue between a user and packet assembler disassembler (PAD), this dialogue has two components. The first is commands that the attached device can input. The second is a set of response call "service signal". Service signal is used to acknowledge X.28 command. It also used to inform the user of network events and/or PAD actions. The data format of service signals of PACNET's build-in PAD are 7 data bit with even parity. For example, the X.28 service prompt of Taipei switching node is PACNET-TPE, where the highest bit of characters C, E and T are set. If an 8 bit Chinese code host/terminal were connected to the PAD, the terminal will be dead-locked because it is unable to distinguish these code successfully.

3.4 STRATEGY TO SOLVE 8 BIT CHINESE CHARACTER CODE DTE'S PROBLEM

In order to solve the problem between PACNET and 8 bit Chinese character code DTE using X.28 interface, there are two strategies will be used:

3.4.1

A stand alone concentrator will be provided to those users, as show in FIG 5. The user terminal through concentrator access to the PACNET. The concentrator is directly connected to the PACNET using X.25 high speed synchronous data link, it has the following parameters can be selected by the users:

1. **The number of bits per character excluding the parity: 5 bits, 6 bits, 7 bits and 8 bits.**
2. **The parity that the concentrator uses in communicating with device terminal: Transparent parity, Space, Mark, Even, Odd.**

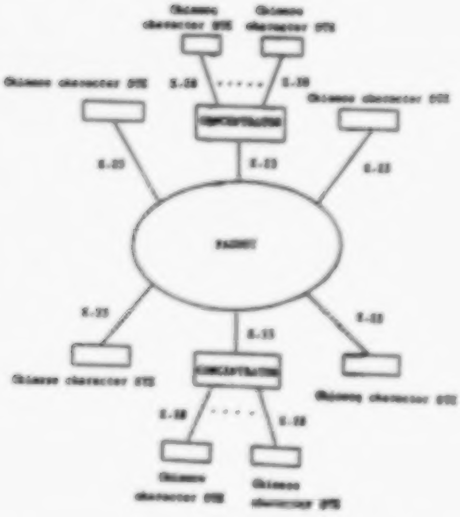
Chinese character DTE
Chinese character DTE
Chinese character DTE
X.28
X.28
Chinese character DTE
CONCENTRATOR
X.25
X.25
X.25
PACNET
X.25
X.25
X.25
Chinese character DTE
CONCENTRATOR
Chinese character DTE
X.28
X.28
Chinese character DTE
Chinese character DTE

FIG 5. 8 BIT CHINESE CHARACTER DTE THROUGH CONCENTRATOR TO ACCESS PACNET

3.4.2

Add the CCITT 1984 X.3 new parameters to the existing system.

1. Editing PAD service signal: for user according to his terminal type to edit the PAD service signal.
2. Echo Mask: allow user to exclude the echoing of certain characters.
3. Parity treatment: allow a user to select whether the PAD should check parity in the data stream received from terminal and/or generate parity in the data stream transmitted to the terminal.

The second strategy of above will be held during the expansion of PACNET network in the near future.

4. NUMBERING PLAN

4.1 GENERAL

The numbering plan for the PACNET is based on CCITT Recommendation X.121. This address consist of 14 digits and one international prefix. That 14 digits are divided into 2 discreted fields. The first field holds the Data Network Identification Code (DNIC). The second field holds the Network Terminal Number (NTN).

4.2 CURRENT PACNET NETWORK NUMBERING SCHEME

4.2.1 DATA NETWORK IDENTIFICATION CODE

The Data Network Identification Code consist of 3 digits Data Country Code (DCC) and 1 digit Network digit. According to the DCC numbering scheme of CCITT X.121 and the geographic area of the Republic of China, the Directorate General of Telecommunication, DGT, of Ministry of Communication, Republic of China, announced that 487 as the DCC of The Republic of China. PACNET is the second public data network in Taiwan, The Republic of China, so that use 2 as its network digit.

4.2.2 NETWORK TERMINAL NUMBERING SCHEME

In the first phase the PACNET network terminal numbering consists of 4 numeric characters. These 4 characters are divided into 2 discrete fields.

1). Geographic area code, 1 digit.
2). Terminal identification number, 3 digits.

The remainder of 6 digits can be used as the terminal subaddress.

4.2.3 INTERNATIONAL PREFIX CODE

PACNET use "0" as international prefix code for its subscriber to make calls to other overseas public packet switched data network.

5. TARIFF STRUCTURE

Currently the tariff structure of PACNET consists of three separate components.

1. Access-a charge for the type of transmission connection to the network. The charge is independent of distance between a terminal and the network. (eq. NT$7000 /Month for 4800 bits/s dedicated synchronous link-including line and modem).

2. Usage-a charge for the volume of data transferd and the connect time. Usage charge are distance independent. (eq. NT$600/Kilosegment, 1 segment equal 64 bytes).

3. Facilities-a charge for subscription to a particular facility such as Closed User Group. (eq. Permanent Virtual Circuit-NT$600/Month).

6. THE FUTURE DEVELOPMENT OF PACNET

6.1 TELETEX SERVICE

It is true that electronic information and text communications increased rapidly in the past few years. The efficiency and competity ot a modern company can be significantly effected by its ability to manage information transport within the organization, and between the organization and its suppliers and customers.

Telex service is the only one public text communications facility that has been available for the past tens years. However, a new text communication service - Teletex is to be introduced.

Teletex is a service developed to provide a better response than telex to modern office requirements for integration of local telex processing with capabilities for national and international communications at high data transmission rates.

In July 1985, 11 CHINTEX terminals, an English/Chinese character code teletex terminal developed by Telecommunication Laboratory, DGT, was connected to PACNET network for text and document transmission between administrations of DGT for trial service. In November 1985 this trial service will be extanded to the public. The normal teletex service of PACNET will be opened in Aug. 1986.

6.2 INTEGRATED NETWORK SERVICE

There are two data network, PACNET, circuit switched network, CIRNET, and one telex network in Taiwan, Republic of China. In order to provide integrated network service among these three networks an interworking unit (IWU) is planning to be provided between PACNET and CIRNET, and a conversion facility (CF) also to be provided betwaen CIRNET and telex network, as show in FIG 6. So that the teletex users on PACNET and those users on CIRNET can direct communication via IWU. It also will be available for those users (PACNET and/or CIRNET) to communicate with national and international telex user community via CF.

A further possible mode of operation which will be evaluate in the near future is for packet-mode terminal located on the public switched telephone network (PSTN) to access its community via X.32 facility to the PACNET network.

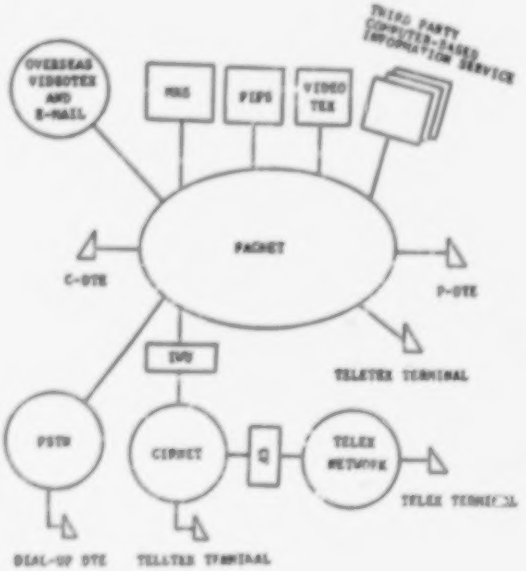

FIG 6. INTEGRATED NETWORK SERVICE OF PACNET

6.3 MESSAGE HANDLING SYSTEM

While teletex (and telex) are good example of synchronous communicating system (ie. sending and receiving entities are in direct connection) there is an important demand for person to person non synchronized information transfer; where communication tasks place independently of the senders and receivers presence (or absence) and location. The storage, or electronic mailbox facility need for this person to person service is now provided by a variety computer based message handling system (MHS).

Data Communication Institute, DCE, is planning to introduce such service in 1986. There will be a high speed X.25 data link between PACNET and MHS, so that the subscribers directly connect to the PACNET network and those through public switched telephone network will be able to access the mailbox of MHS, as well international traffic from packet switched network in other countries.

7. CONCLUSION

In the next few years the number of network ports is expected to grow rapidly and inorder to maintain PACNET's high levels of switched data performance and good service grade, an expansion of the network is under evaluation. Other features which would enhance the capability of PACNET, such as RPOA selection of X.75, Module 128 on link level of X.75, Dial-Out to the public switched telephone network are also planning to be introduced.

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A Report on the INS Experiment

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Abstract

The INS Model System, constructed as a pilot plant, started operation on September 28, 1984, for a period of two and a half years. One point to be covered in this lecture is the changing state of the experiment over the past fifteen months. In this regard, the current status of service usage, opinions and requests for new services and IP information will be introduced.

1. Foreword

As a result of innovations in electronic technology, Japanese society is rapidly becoming an advanced information society. Accordingly demand for diversified and sophisticated telephone and non-telephone services, such as facsimile and data communications is increasing. To meet these increasing requirements, NTT has proposed the Information Network System (INS). The INS is aiming to provide economical, convenient and diversified telecommunications services through the digitization and integration of a nationwide network. It is expected to play an important part in the basic infrastructure of the advanced information soceity of the future.

Prior to commercial introduction the INS Model System, involving experiments conducted at a pilot plant, started operation on September 28, 1984 both in the Mitaka/Musashino area, 18 kilometers from central Tokyo and in the central business district of Tokyo. The experiment, through the participation and cooperation of enterprises, local administrative bodies and local residents in the experimental area, will run for two and a half years.

One point to be covered in this paper is the changing state of the experiment over the past fifteen months. In this regard, the current status of service usage, opinions and requests for new services and IP information will be introduced.

2. INS Model System

1) Objective of the experiment

The main objectives of the model system are, to confirm the technical feasibility of providing digital connections between user terminals, to survey customer acceptability and uses of the INS, and to offer opportunities to develop new utilization of communications services.

2) System Configuration

i) Basic Configuration

The model system is divided into two systems: a 64kb/s digital network system which provides telephone and non-telephone services at a speed of 64kb/s and 16kb/s, and a broadband network system which provides 4MHz image and 1.5Mb/s digital information. (Fig. 1 Basic Configuration of the Model System)

Telephones, facsimiles, videotex, and telewriting termfinals are connected to a digital switching system in the 64kb/s digital network system. These terminals are connected to communications processors via a toll switching system. The communications processors provide a diversity of services including information storage and conversion. The model system is equipped with five communications processors for facsimile, voice, still picture, data and messages. Connected to the broadband network system are video terminals such as video-conference ultra-high-speed facsimile and color facsimile equipment.

The broadband network uses optical fiber cables in the subscriber's lines. However the 64kb/s network uses existing pairs of metallic cables for time-compression multiplex transmissions. The 64kb/s network is also being incorporated into experiments to transmit 4MHz video signals and 64kb/s and 16kb/s signals through one optical fiber cable by using the wave length multiplex technique.

The model system offers varied services, and is connected to the existing network to enhance the effect on the experiment. (Table 1: List of Services Offered)

ii) Experimental Terminals

The experiment employs 450 digital telephones, 1,050 non-telephone terminals, 200 analog CAPTAIN terminals, and one integrated centralized extension system. In order to test the digital switching system of both analog and digital telephones, the model system uses 8,400 analog subscriber lines in its digital switching system.

Monitors use experimental terminals in various combinations. Combinations can basically be classified into either 64kb/s services or 64kb/s service plus broadband services. (Fig. 2: Example of Terminal Connection)

3) Monitors and IPs

A total of 2000 monitors will participate in the experiment during the two and a half year period. Each monitor will be replaced every six months to involve as many monitors as possible. Approximately 550 monitors participate during each six month period. Model system monitors can obtain stored information through center-to-end communication as well as utilizing end-to-end communication. At present, approximately 250 companies are participating in the model system as information providers (IP). (Table 2: Number of Monitors and IPs)

3. Confirmed Functions and Services

Experiments are being conducted on the model system to test the technological feasibility of the INS. The experiments began at the start of construction in September 1982 and are being conducted with the aid of monitors and information providers. NTT obtained valuable results in terms of the technological feasibility of future nationwide services, such as digital local switching system, subscriber-line transmission system, various communications processors and subscriber terminals. Based on the results of these experiments, NTT is finishing preparation work for the commercial introduction of 64kb/s digital circuit services. (Table 3: Confirmed Functions and Services)

4. Service Utilization by Monitors and IPs

As an infrastucture, the INS will contribute greatly to the formation of various network systems which for an advance information society, will help solve various problems in areas such as corporate, home, and local administration.

A wide variety of applications and uses of the INS need to be developed and introduced for the INS to gain popularity in the future.

As the experiment proceeds, various uses are being studied, includining a method to provide information and connect the INS with equipment made by other companies. For example companies are testing the use of integrated centralized extension systems, satellite offices, and home-shopping, home-banking services. Municipal offices provide local administrative information and transmit residence certification documents. Also tested is the possibility of transmitting ultrasonic diagnostic images among medical institutions, lectures among universities, and club information among its members. (Table 4: Service Utilization of the Model System)

Following are recent major trends in service utilizations:

1) Improving the content of information provided

At the early stage of the experiment, some monitors complained that the information provided by IPs through Video Response System (VRS), digital CAPTAIN and voice storage service contained a lot of corporate promotion. Presently IPs have began to provide useful and beneficial information such as news, local community topics, shopping and leisure guides.

2) Experiment by the private companies' study group

Private companies have formed many study groups to research the possibility of offering newly categorized information, information from local community members and home-shopping as well as testing new terminal equipment. Various kinds of experiments have just started.

3) Interconnectivity with other company-made terminals

Advancements in interconnecting the INS network with other company's digital telephone equipment, and in transferring supersonic pictures via the 64kb/s channel and broadband channel have been made.

5. Opinions and Requests of Monitors and IPs

1) Reasons for Participating in the Experiment

Home monitors participated in the experiment because they were "interested in equipment and services," "interested in information offered by IPs," and believed that the "services are useful for improving daily life." Office monitors and IPs were interested in participating "to learn INS techniques and know-how," "to confirm the possibilities of experimental services," "to improve customer services by offering information," and "to experiment with new activities."

2) Impact of INS

i) Expectation and Concerns of Home Monitors

Home monitors expect a "richer life by getting a variety of information," "diversified and rationalized daily life," and "increasing free time for individuals." On the other hand, concerns were expressed that "the difference in ability to utilize information contributes to further widening the gap between individuals and companies," and "disruption in daily life if an accident occurs," "possibility for privacy violations increase," and "housing functions will rely more on the outside."

ii) Effects on Corporate Activities

Office monitors and IP corporate activities will be influenced in the following three ways: "improvement in information management," "diversification of means for advertising and public relations," and "development of new business."

3) Opinions and Requests on Equipment and Services

Monitors involved in the experiment are satisfied with such characteristics and functions of the network as its quick transmission speed, improved picture quality, speed conversion, multi-addressing and media conversion.

However, since the monitors are provided with prototype equipment which is below the commercial level, there were requests for more compact, multi-functifonal, and easier to operate terminal equipment.

i) 64kb/s Service

- Of the digital telephones new functions such as the indication of calling party's number and indication of the charge for the call are highly evaluated.

- Voice storage box and message transmitting services are versatile because they can be used by telephone which is the most popular home equipment for a variety of purposes.

- Digital facsimiles are popular among home monitors because they leave messages, and provide copy functions.

- Digital sketchphones are appreciated by those with hearing impediments. They also leave messages as facsimiles do.

ii) Broadband Service

Much expectation is being placed on broadband services.

- Video conference and TV telephone services are highly evaluated by companies due to the two-way video and audio communications.

- Video Response System (VRS) has a high potential and is well utilized. Companies pay more attention to private than public use.

4) Requests from monitors on the content of information

The model system makes the variety of information supplied by the IPs available to monitors through such media as CAPTAIN, VRS, and voice storage service. Different from TV and magazine advertisements, this information must be requested by the receiver. The information content should therefore be beneficial to the receiver.

In the model system, monitors prefer updated information which rapidly changes its content, information retrieval services, and processing services including reservations. On the other hand, monitors do not like overly advertisement-oriented information.

To further develop new telecommunications media in the future, it is deemed important for each IP to provide information which adequately takes advantage of the characteristics of the media.

6. Future Program

1) Promotion of Utilization Experiment

To promote the nationwide expansion of the INS, it is necessary to make efforts in forming a variety of useful network systems and developing diversified applications in each the company, home and local administration sector.

Technical confirmation experiments of the INS model system are achieving results as expected. NTT will conduct the experiments focusing on the utilization of the INS system in the future, which are: 1) more comprehensive experiment of the INS involving any of the citizens in addition to the monitors and IPs; 2) providing "information truly beneficial for receivers" through exchange between senders and receivers of information; 3) promition of experiment by adding new equipment and services.

2) Tasks of telecommunications business

The INS aims at the formation of a network which has high universality and is responsive to the diverse customer demands.

To this end, the telecommunications business must satisfy customers' needs by developing more sophisticated technology, and providing services at reasonable charges.

Also the more efficient provision of information via a shared information center and the security of information systems have become clearly important in the experiment.

In addition to meeting the above requirements NTT will continue its efforts in the experiment to discover social objectives which will develop as Japan evolves into an advanced information society.

# # #

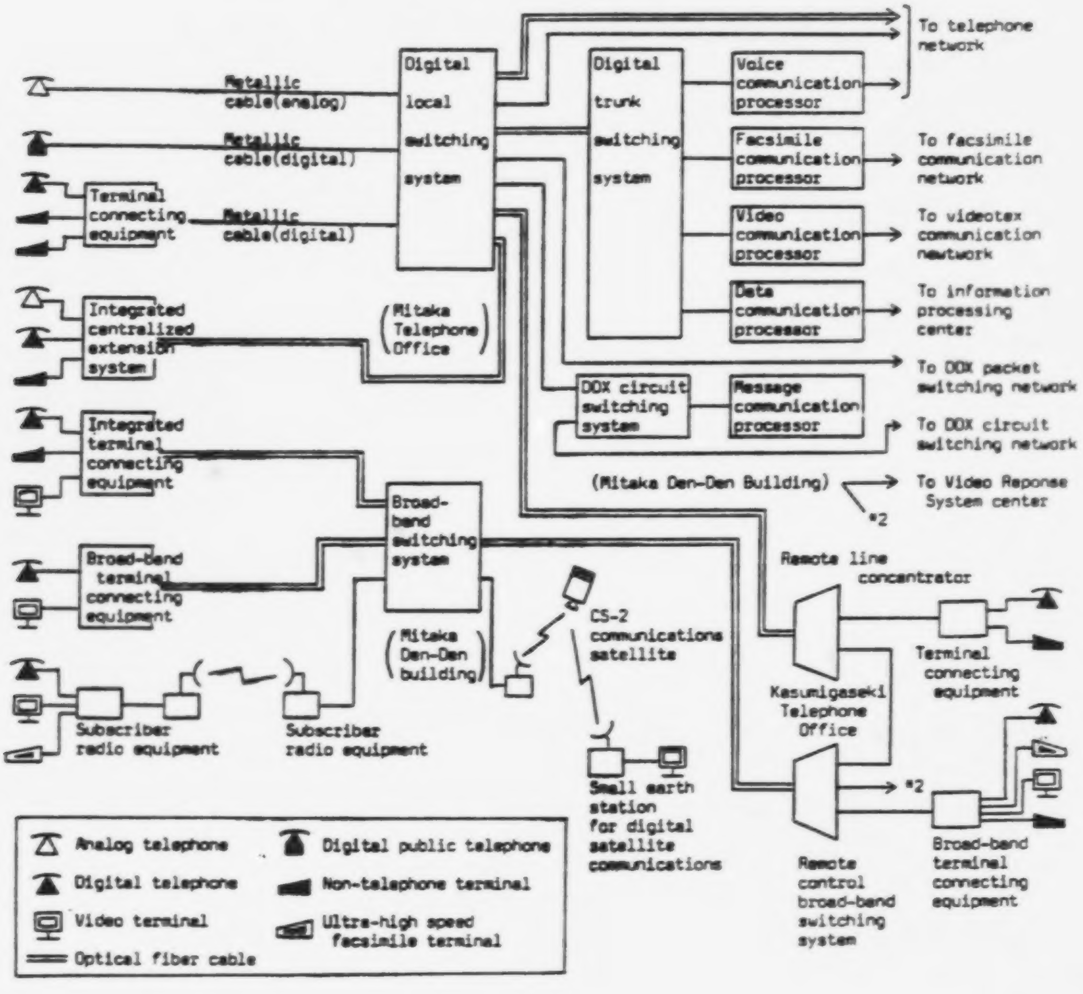
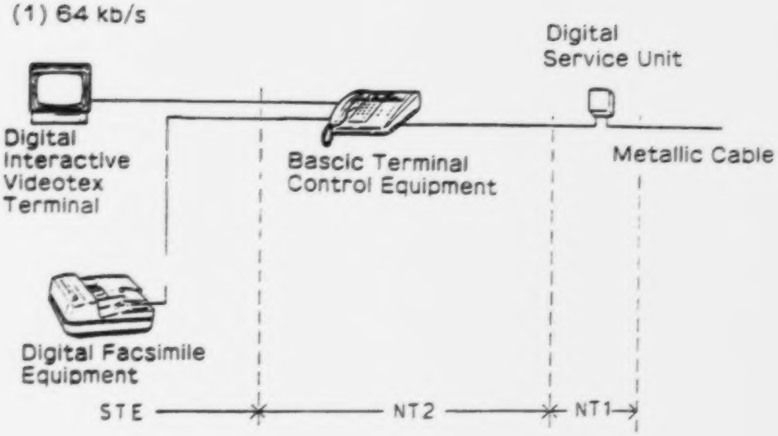

To telephone network
Metallic cable(analog)
Metallic cable(digital)
Terminal connecting equipment
Metallic cable(digital)
Digital local switching system
Digital trunk switching system
Voice communication processor
Facsimile communication processor
To facsimile communication network
Video communication processor
To videotex communication newtwork
Data communication processor
To information processing center
Integrated centralized extension system
(Mitaka Telephone Office)
To DDX packet switching network
DDX circuit switching system
Message communication processor
To DDX circuit switching network
Integrated terminal connecting equipment
(Mitaka Den-Den Building)
To Video Reponse System center
*2
Broad-band switching system
Broad-band terminal connecting equipment
Remote line concentrator
CS-2 communications satellite
(Mitaka Den-Den building)
Terminal connecting equipment
Kasumigaseki Telephone Office
Subscriber radio equipment
Subscriber radio equipment
Small earth station for digital satellite communications
*2
Remote control broad-band switching system
Broad-band terminal connecting equipment
Analog telephone
Digital telephone
Video terminal
Optical fiber cable
Digital public telephone
Non-telephone terminal
Ultra-high speed facsimile terminal

FIGURE 1 BASIC CONFIGULATION OF THE MODEL SYSTEM

Service				Major Features
64kb/s System	Telephone		Digital Telephone Service	· Add-on, Call charge display and calling party's number display
			Digital Public Telephone Service	· Remaining time display, Warning alarm for the termination of call, Dial reset
			Voice Storage Service	· message transmission service · Voice storage box · Pre—recorded information service
	Non-Telephone	Facsimile	Digital Facsimile Communication Service	· Acceleration of communication speed by digitization · Communication between different types of terminals through the storage and processing functions and center-to-end communications
		Still-Picture	Digital Interactive Videotex Service	· Acceleration of visual transmission and indication speed · Precise display with voice
			Digital Telewriting Communication Service	· Simultaneous communication of voice, hand-written information
		Data	Multi-media Database Access Service	· Easy information provision with voice, graphics and characters provided by the data base center
			Message Communication Service	· Efficient document distribution by using the storage, processing and distribution functions
			DDX Circuit Switching Service	· Circuit switching service by connecting with conventional circuit switching system
			DDX Packet Switching Service	· Packet switching service by connecting with the conventional packet switching system
	Multiplex		Multi-media Communication Service (end-to-end)	· Multi-media communication service with the combined usages of telephone and non-telephone terminals
			Integrated Centralized Extension System	· Telephone and non-telephone service at business offices · Voice storage service
Broadband System	Visual		Video Telephon Service Video Conference Service	· Conferencing in remote areas with high voice quality and moving color pictures
			Video Circuit Service	· Remote surveillance and relay by one-way video transmission
			Video Distribution Service	· Information provision of motion picture from CATV. etc.
			Video Response System (VRS)	· Information provision of motion pictured data base
			High-definision TV Transmission	· Transmission of high-resolution color images (private line)
	Facsimile		Ultra-high-speed Facsimile Communication Service	· Ultra-high-speed and high precision transmission of documents and graphics
			Color Facsimile Communication Service	· Transmission of color documents and graphics

TABLE I LIST OF SERVICES OFFERED

(1) 64 kb/s


Digital
Service Unit
Digital
Interactive
Videotex
Terminal
Bascic Terminal
Control Equipment
Metallic Cable
Digital Facsimile
Equipment
STE
NT2
NT1

(2) 64 kb/s and Broadband

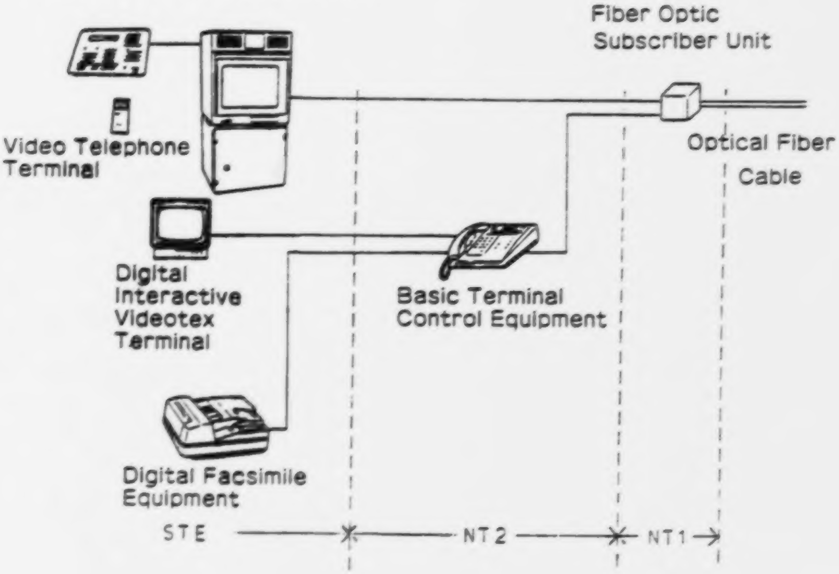

Fiber Optic
Subscriber Unit
Video Telephone
Terminal
Optical Fiber
Cable
Digital
Interactive
Videotex
Terminal
Basic Terminal
Control Equipment
Digital Facsimile
Equipment
STE
NT2
NT1

FIGURE 2 EXAMPLE OF TERMINAL CONNECTION

1. Monitors

Period		Sept. 1984	Dec. 1984	April 1985	Oct. 1985
Number of Monitors		148	346	546	541
Places for the installation	Home	36	198	233	248
	Business offices, etc.	91	112	277	256
	Local administration, etc.	21	36	36	37

2. IPs

	September 1984	December 1984	April 1985	October 1985
VRS	69	96	161	167
Voice Storage Service	18	21	71	71
Digital Interactive Videotex Service	-	-	114	118

TABLE 2 NUMBER OF MONITORS AND IPS

(1) 64kb/s system

Subsystem	Major confirmation of system functions and services
Local switching system	• Basic functions and various services • Mixed capabilities of digital/analog subscribers • Scale of approximately 10,000 subscribers • Remote line concentrator system
Communication processing	• Gateway function for communications processing • Communications processing functions (voice storage, still-pictures, facsimile, message)
Subscriber-line transmission system	• Time compression multiplex transmission system using existing pairs of metallic subscriber lines • Power supply to digital service unit and digital telephone from telephone office
Terminals	• Basic functions and services of digital telephone, integrated centralized extension system, terminal control equipment, etc.
Others	• Maintenance center function • Traffic data collection function

(2) Broadband system

Subsystem	Major confirmation of system functions and services
Broadband switching system	• Basic functions and various services • Remote control switching • Reservation connection function • Multi-point communication control function
Subscriber transmission system	• Optical fiber technology • Two/four-wave multiplex technique • Subscriber radio transmission system
Terminals	• Basic functions and services of video terminals and facsimile

TABLE 3 CONFIRMED FUNCTIONS AND SERVICES

Category	Examples of Uses
Company	1. Sales/marketing activities a) Home shopping (digital telephone, digital facsimile, CAPTAIN, VRS) b) Home banking (inter and inter-bank transfer, inquiries, information) (CAPTAIN) 2. Corporate INS Construction of in-company integrated communication system connecting Mitaka plant and Tokyo head office by the integrated centralized extention system (integrated CES,TV telephone, ultra-high-speed facsimile) 3. Diversified forms of duty services a) Experiment of new system connecting a downtown office with a Mitaka satellite office (NTTX, sketchphone, digital facsimile) b) Remote operated surveillance system (video circuits) c) Remote planning/production printing system (discussion for planning, proofing) (TV telephone, ultra-high-speed facsimile) 4. Review of current business b) Gas station as information center --- supply driving information (CAPTAIN, VRS) 5. Community information a) Information salon --- supply of community information and data base service (CAPTAIN, personal computer) b) Tutor information by electronic message board, information on big sale (CAPTAIN)
Local Organization	1. Improvement of citizen service a) Information on local administration, and major events (CAPTAIN, VRS) b) Immediate resident certificate transmission (ultra-high-speed facsimile) c) Communication services with persons with impaired hearing (telewriting) 2. Medical field uses and experiments a) Supersonic picture transfer, X-ray fluoroscopy picture transfer, endoscope picture transfer (TV telephone, high-definition digital CAPTAIN) b) Vaccination information, medical information such as home doctor (CAPTAIN, VRS) 3. Educational field uses and experiments Lectures and sysmposiums from remote places, education programs to citizen (Video conference, video distribution) 4. Town information a) Introduction of shops, sales information, living, etc. (CAPTAIN, audio information) b) Information provided by consumer organizations (detergent information, etc.)(CAPTAIN)
Home Monitors	1. Various usages Transfer translation materials, correct calligraphy homework, circle eport, tranfer community paper (Digital facsimile) 2. Individual information Information from pharmacies (Voice storage)

TABLE 4 SERVICE UTILIZATION OF THE MODEL SYSTEM

INTEGRATED SERVICES DIGITAL NETWORKS IN THE UNITED STATES AND JAPAN: A COMPARATIVE ANALYSIS OF NATIONAL TELECOMMUNICATION POLICIES

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Abstract

The drive for ISDN started outside the U.S., mostly by Japanese and European PTTs. These undertakings present many challenges to the U.S. where telecommunications have left to the private sector, apparently more innovative. This paper examines the issues surrounding the development of ISDN, such as standardization, tariff policy, users' needs, and the different economics and regulatory environments in the U.S. and Japan, with occasional references to Western Europe.

I. Introduction

Today's society is in the midst of an information revolution whose social impact will more than match that of the Industrial Revolution transforming the society from a labor-intensive to a knowledge-intensive society. The primary motivation for this revolution is the need for growth in the economy through increase in efficiency.

The largest and fastest growing segment of the economy is the information industry. The traditional division of the economy into agriculture, manufacturing, and services sectors has concealed the fact that information production and dissemination, and the means to manage information, account for over half of the Unites States' GNP. For the information industry's productivity to continue to grow, ubiquitous, low-cost, rapid access to information is necessary (1).

Other regions of the world, such as Japan and Western Europe, where a single government agency, the ministry of posts, telegraph, and telephone (PTT) dominates,have embarked on ambitious plans to adopt the digitized information system known as integrated services digital networks (ISDNs) in order to enhance the information economy.

The concept of ISDN has been the subject of extensive discussion, primarily on a technical and operational level. ISDN has been described as "a network which is designed and constructed to provide a wide range of telecommunication and information services and to transmit electrical signals in digital, rather than analog, form." Most ISDN planning efforts have taken place in the context of the International Telecommunication Union's Consultative Committee on International Telegraph and Telephone (CCITT).

The drive for ISDN started outside of the United States, mainly by Japanese, German, British, and French PTTs. These undertakings present a challenge to the U.S. where telecommunications have been left to private sector, apparently more responsive to the marketplace. There is little doubt that the CCITT specifications will have far-reaching implications for the development of ISDN worldwide.

In the U.S., concerns and criticisms have been voiced regarding the implementation of such all-digital service networks. Some question the very existence of ISDNs. Others cast doubts regarding the process of achieving efficiency. Yet others are concerned with ISDN's negative impacts on market competition.

Japan, as well as the U.S. and the United Kingdom, is in the forefront of a recent deregulatory trend in telecommunication industries. The telecommunication industry in Japan has been going through drastic changes in many facets of operations after the privatization of Nippon Telegraph and Telephone Public Corporation, in April of 1984. This industry is in a transitional period from a monopolistic environment to a controlled competitive environment. ISDNs in the U.S. will be implemented in a competitive, multi-vendor environment. Thus, there will most likely be more than one ISDN in the country. On the other hand, Information Network System (INS), the Japanese equivalent of ISDN, will be implemented mainly by a dominant carrier, NTT, in a policy environment which is similar to that of West European countries.

The issues around the development of ISDN and the policy framework within which it will be implemented in two countries, the United States and Japan, will be analyzed. Even though the implementation of ISDN in the U.S. and that of INS in Japan appears very different for casual observers, the two countries share various common concerns and problems. This comparative analysis may be used as a case study for many other nations which will face a similar situation in the future.

This paper will first provide the definitional framework of ISDN. It will then examine the role of the main actors that shape the planning and implementation of ISDN, namely the international standards bodies, national telecommunication administrations, private network operators, users, and ISDN-related equipment manufacturers. The issues surrounding ISDN developments, such as standardization, tariff implication, user needs, and different economic and regulatory environments in the U.S. and Japan, will be discussed. However, to make the analysis more comprehensive, occasional references will be made to ISDN developments in Europe as well.

II. Technical Definition of ISDN

For approximately 100 years, telephony meant analog voice signals on analog systems. Telephone is suitable for handling human speech signals. On the other hand, in the last 20 years, it has become a common practice to transmit digital information, such as signals used by computer terminals. That is how modems come about to convert digital signals into analog form for transmission over the telephone network and vice versa.

In the past two decades, voice telephony began to benefit from the advent of digital technology in two areas: (1) economical digital transmission of voice signals between telephone central offices either via cables, or microwaves, and, later, optical fibers, (2) more recent technological breakthroughs materialized digital switching. All switch manufacturers are now planning to digitize central office and private switches. This combination of digital switching and digital transmission is called an Integrated Digital Network (IDN).

Additionally, if analog signals are digitized at their origin, even greater economies of scale and flexibility can be achieved. This is the concept of Integrated Services Digital Network (ISDN)(2).

Business applications, in particular are likely to be a principal use of ISDNs. Since it will provide considerable data capabiltiy at lower costs than through existing modems (3).

With so many things being called ISDN by various people, it is essential to define further what is meant by the term ISDN. On the basis of agreements so far reached by the CCITT, the ISDN is characterized by the following basic features: 1) It is based on the digitized telephone network - the Integrated Digital Network (IDN). From this point of view, the ISDN is primarily a circuit-switching network, but it is intrinsically capable of dealing with packet switching data traffic as well. 2) The subscriber-to-subscriber connections are digital throughout. 3) Two interfaces have been agreed upon depending on the usage: basic and primary rate. The basic interface comprises two 64-kbits/s full-duplex channels (B-channels) and one 16 kbits/s signaling channel (D-channel). Each of the two B-channels allows simultaneous transmission in both directions, also to two different destinations. The two B-channels can also be combined to form a single 128-kbit/s channel. The D-channel transmits the subscriber signaling information required for the two B-channels. The information carried in D-channel is packet-oriented (4). The primary rate interface is based on the two different digital-link bit rates of 1.544 Mb/s (for North America and Japan) and 2.048 Mb/s (for Europe). This interface will be used to connect an integrated digital network provider and a large customer such as a PBX or LAN user who needs wide bandwidth and large capacity (5).

In the U.S., and Japan, however, there is an alternative ISDN contender to terrestrial carriers, i.e., satellite. This possibly seems to be more immediate in the U.S. because of existing entities such as Satellite Business System, (SBS) and American Satellite Company (ASC) which provide specialized business services.

Digital systems have only to process binary digits. Transmission, logical processing, storing, switching of bits can be performed through nationwide integrated systems in highly concentrated, space effective technology, which becomes very cheap if produced in large quantities. Digital transmission and switching systems are now becoming cost-effective also for long-haul and for higher multiplex levels (6).

Furthermore, the economics of the dominant voice service should be able to support the other services at marginal cost (7).

Apart from cost benefits and advantages offered to the users, the digitization of the existing networks features some other important aspects. The terminal equipment built today is defined for a particular service. The more telecommunication services required by the customers, the greater the desire not having to operate three or four different types of terminal equipment, but to have compact terminal equipment with which several services may be handled simultaneously and optionally (8). Apart from the facilitation of operation of the equipment which is an important factor for the acceptance by the customers, considerable savings can be achieved with such "multi-purpose" terminal equipment by the technological development and by combination of functions.

Digital networks also offer the possibility to increase the service quality of the network. With information encoded in digital form, a number of error-detection/correction methods are available to protect the information flow in the network and to render its control functions more reliable (9).

One ISDN feature which is especially attractive to network providers is that it allows an evolution toward services without knowing what the demand mix of these services will be. Since it takes many years to upgrade these large and ubiquitous networks to new capabilities, having this feature is essential to deal with service forecast uncertainties. If, indeed, all access to other networks and information services will be carried on a "digital pipe" of appropriate cross section, any mix of services will be accommodated in ISDN. Network providers will thereby ensure that they will not find themselves with the wrong capabilities 10 years from now (10).

III. The Main Actors in the Development of ISDN

To trace the not-so-long history of ISDN, several main actors are at work. Internationally, the CCITT and the International Standards Organization (ISO) are involved in developing ISDN-related standards (11).

The CCITT was founded nearly 30 years ago as a permanent body of the International Telecommunication Union (ITU) with the aim of harmonizing the technical, operational and tariff aspects of international telecommunication services. One of its principal mechanisms is to draw up particular study questions for consideration by expert groups throughout the world, in which ISDN has been a subject of vigorous discussion since 1976 (12).

The ISO was established after the Second World War to promote global standards with the specific aim of facilitating trade and encouraging cooperative research (13).

The focus of harmonization efforts in Europe is the European Conference of Postal and Telecommunications Administrations (CEPT). The CEPT was created in 1959 to facilitate cooperation among 26 national telecommunications administrations (PTTs) (14). CEPT is relevant to U.S. industry particularly in its role as adviser to the European PTTs in dealing with international transmission services and the introduction of non-European technical procedures (15).

1. The Consultative Committee on International Telegraph and Telephone - In recent years, there has been growing criticism of the speed at which the CCITT operates. It has also been said that in some areas, notably ISDN—which is an important part of the organization's last study period —unilateral action by national service providers or equipment manufacturers could render CCITT recommendations irrelevant (16).

Its new director, Theodor Irmer, is aware that today the CCITT is operating in a very different environment than the environment which existed at its inception. There are several elements at work. The continuing convergence of different telecommunication services inevitably has led the CCITT into areas which were formerly the exclusive domain of PTTs.

At the same time, the speed of technological development has dramatically enlarged the expectation of user communities everywhere. Meanwhile, in some parts of the developed world the trend toward deregulation is enlarging the number of telecommunication service providers.

Finally, the input from the supply industry, which was once confined to submission from capital equipment manufacturers, now involves many sections of the semi-conductor community. Now there are many more interests, some of which are contradictory.

Despite this greatly increased workload and diversity, the CCITT is operating in a somewhat reduced capacity. Concern about the overall cost of ITU operations already has led to a vote in favor of 10% reduction in staffing levels for the whole organization (17).

Irmer acknowledges that if the CCITT does not fulfill its role as the arbiter of world telecommunication standards, other entities, such as regional PTT organizations, and dominant manufacturers of ISDN-related equipment, will step into the arena with alternative solutions (e.g., establishment of de facto standards) (18).

That is precisely why the standardization and coordination of international telecommunications at CCITT becomes more important than ever. Standardization ensures internationally compatible equipment and operations enabling countries to plan and provide appropriate interfaces wherever necessary (19).

Yet, there are some who feel that standardization might freeze further developments and innovations once a standard is set. Members of CCITT are conscious of this argument. It should be recognized that CCITT standards, in certain high-technology areas, could have shorter life-span than the standards established in less hectic times.

There has been an important change of policy in the standard-setting activities of the CCITT which came about with the study of new services. The traditional services used to be defined in such detail that there was not much room for the addition of options in international services. With the rapid pace of technological development, it has become apparent that, at least in some very innovative areas such as ISDN, the CCITT should standardize only basic services which would always be available worldwide.

In addition, there are private-use options, as offered and defined by individual manufacturers and service providers competing with each other. These latter options are not standardized by CCITT but left to the discretion of countries, telecommunication entities, service providers, or manufacturers. Thus, innovation is channeled toward recognized options and private-use options. The important result of this policy is that CCITT has succeeded in maintaining international compatibility for basic services while permitting innovative developments in the field of options (20).

Yet, another opinion on the role of the CCITT comes from a former official of the Department of Trade and Industry in the U.K. He maintains that the CCITT Study Group which consists largely of telecommunications engineers is unlikely to be able to resolve the key questions about the shape and protocols of the ISDN precisely because their resolutions are dependent upon a variety of factors beyond the control of the CCITT, e.g. the pace and type of service demand from users, the status (governmental body or private enterprise company), market environment (monopoly or liberalized) of network operators, the speed and quality of new technological and software developments, and the response of relevant industries (21). As it will be pointed out later, once again, the members of CCITT are aware of these drawbacks.

It is because of these factors, among others, that the Swedish and Japanese initiative to hold a World Administrative Telephone and Telegraph Conference (WATTC) was endorsed at the ITU Plenipotentiary Conference at Nairobi in 1982, but no place was found for it in the ITU conference calendar until 1988 (22).

Can the world wait until after 1988 for internationally agreed standards? This seems doubtful in the wake of plans in Europe, North America and Japan to have ISDN-type services, managing computer and communication technologies.

For example, to launch the construction of the INS model system in Japan, Nippon Telegraph and Telephone Company (Public Corp. at the time) had to release the specifications of the interfaces in 1983, which turned out to be different from the recommendations made by CCITT at the plenary assembly in November, 1984 (23).

The CCITT helped to develop standards and interface specifications as the voice communication technology and network developed over a number of years. The issue of ISDN is much more complex; the technology is moving much faster, and the leading manufacturers and network operators in the world are locked in an intense competitive struggle to win the lion's share of this new and highly sophisticated market. Some argue that by postponing the WATTC to 1988, the ITU did not show a full appreciation of the new technological forces at work in telecommunications. The convergence and rapid development of new advanced network services are bringing new players such as IBM and other worldwide data processor companies more into the center of network operation. If some of European and Japanese PTTs respond by making critical decisions on the future of ISDN independently of CCITT, or if the work in the ISO deviates significantly from related CCITT work, there will be a question mark over the practical relevance of the CCITT for some advanced countries (24).

In the U.S., ISDN planning has included governmental organizations, the major ones being the Federal Communications Commission, the National Telecommunications and Information Administration (NTIA) and various private organizations through some fora such as the USCCITT and the T1 Committee approved by the American National Standards Institute (ANSI).

Official membership of the United States in the CCITT is through the Department of State, Bureau of Economic Affairs, Office of International Communications Policy. The USCCITT, established in 1972, is composed of a national committee and five study groups: Regulatory Matters, Telegraph Operations, Telephone Operations, Data Communications, and the ISDN joint working group. Members in the USCCITT study groups including users, carriers, manufacturers, national standards organizations, and government agencies. Membership is secured through the chairman of the desired study group, not through the State Department (25).

2. The T1 Committee - It is one of the most important sources of U.S. ISDN standard-making; an independent organization which develops interconnection standards for the U.S. telecommunications network. "T" stands for telecommunication, and "1" for the first T committee (it is not related to the 1.544-Mbit/s T1 specification).

Membership in the T1 Committee is open to all parties interested in telecommunications and is currently composed of exchange carriers, interexchange carriers, resellers, manufacturers, vendors, government agencies, user groups, consultants, and liaisons. The Exchange Carrier Standards Association, or ECSA, a trade association of wire-line exchange carriers, functions as T1 Committee's secretariat and administrative bodies (26).

The ANSI, the parent body of the T1 Committee has been designated by the Congress, since 1979, as the "chosen instruments" to represent the United States in the setting of international standards, particularly in dealing with nongovernmental standards organizations abroad. It is a coordinating organization with close relationship with the Electronic Industries Association (EIA), the Institute for Electrical and Electronics Engineers (IEEE) and key research institutes such as Bell Labs (27).

3. The Federal Communications Commission - The Commission has released a Notice of Inquiry (FCC Docket 83-841) on ISDN in August, 1983 which asked for technical advice and policy recommendations and addressed a basic question in the effort of developing a global network: How can U.S. procompetitive policies be reconciled with the notion of creating a centralized, integrated telecommunications system? It stated that international planning groups for the ISDN have envisioned the network as eventually reaching around the world, efforts have been made to develop uniform technical standards and protocol designs (28).

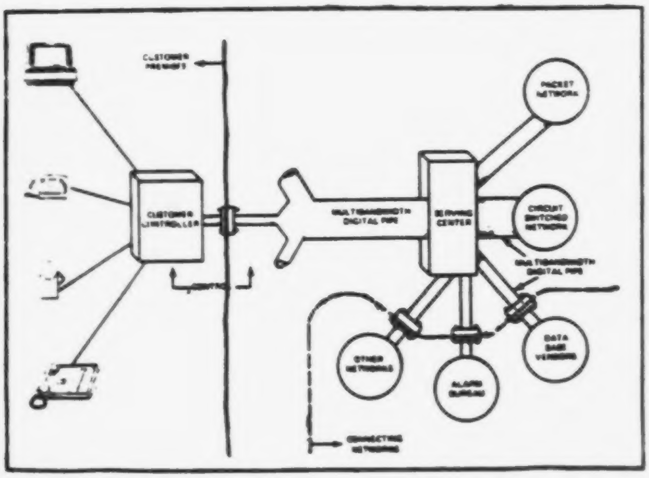
According to its interpretation, uniformity, while it might be desirable for an ISDN, militates against the development of a highly competitive market involving a multitude of service and equipment providers. Only in the U.S. is this a problem, since in most of the other countries, highly centralized national monopolies provide telecommunications services, and in some cases, equipments as well.

Recognizing the problem, the FCC prepared in 1982, and the USCCITT Committee on ISDN approved, a contribution to the CCITT stressing the need for an ISDN to be flexible enough to accommodate differing national systems. Key questions are whether ISDN standards developed by the CCITT will accommodate U.S. desires to give the user choice of routing and media for an ISDN under prevailing national conditions (29).

To examine those key questions more specifically, many regulatory and legal issues were addressed in the Notice of Inquiry. Some of which are: 1) how to accommodate current private-line users within an ISDN; 2) whether an adapter that would allow incompatible U.S. customer premise equipment (CPE) to gain access to ISDN would be technically and economically feasible; 3) whether a regulatory construct could be devised that would categorize ISDN services in a manner that would comport with FCC's Computer Inquiry II decision in dealing with equipment and service providers (30).

To clarify what was meant by those statements, an account of the chain of events which precipitated the issuance of the Notice of Inquiry needs to be presented. In June, 1983, the FCC took a decision concerning Dataphone Digital Service (DDS) provided by AT&T and rules that the channel service unit (CSU)--which is used to terminate the service and which provides an access line terminating repeater, maintenance loop-around and signal conditionings--belongs to the customer, i.e. customer premise equipment (CPE). It is not part of the network. Accordingly, AT&T filed tariff revisions that detariffed the CSU effective August 24, 1983. Furthermore, the FCC extended this ruling to include not only Dataphone Digital Service, but all digital services. It implies that, in the U.S., digital services must terminate in bare wires (or bare fiber) rather than in the network channel terminating equipment (NCTE) chosen by the planners of public networks and industry standards fora (31).

On the same day AT&T filed its tariff revisions, a number of Regional Bell Operating Companies (being precluded from installing the equipment) filed for reconsideration to the FCC. They argued that insufficient notice was given, that the decision would violate the preliminary international understandings already reached at the CCITT, and runs counter to the FCC's Computer Inquiry II. (See Figure 1: a continuous line indicates the partition between the CPE and the public network established by the CCITT, and a dotted line indicates the partition established by the FCC).



The Regional Bell Operating Companies, later joined by the U.S. Independent Telephone Association (USITA), also argued the FCC partitioning of the network, however, will inhibit introduction of new services, because it makes standardization particularly difficult. And without standards, there will be no competition and end-to-end compatible services will not occur (32).

Also, the FCC ruling would remove from the network side of the interface, the network termination 1 (NT1) equipment which can provide functions such as line termination, maintenance, testing, multiplexing and power feeding. This would likely to put the quality of the public network in jeopardy, because of inadequate maintenance access to the loop and the NT1.

Another serious consequence would occur, they argued, if a customer disconnects his/her network channel testing equipment, on which the network provider has no control. It would cause system abnormalities likely to degrade the performances or cause service cutoffs for some customers, they claimed (33).

Furthermore, if the CPE has to be changed or modified to accommodate every technology advancement in the network, innovation by the network provider will be stifled. Coordination of such transitions will be virtually impossible. The FCC plan, therefore, has been said to increase the total price of communication by restricting significant competition and inhibiting new technology (34).

Opposition to the RBOC's petition, supported by the above arguments, was lodged in late August, 1983 by IBM Corporation, the Independent Data Communications Manufacturers Association, the North American Telephone Association, the Justice Department and the NTIA.

The Justice Department cited a couple of procompetitive decisions dating back to the 1956 Hush-A-Phone decision.

Another document issued by the NTIA was cited by the Jutice Department:

> 1. There seems to be technical reasons why the function performed by the CSU or similar terminating devices cannot be desegregated from the transmission functions of the network... 2. We have failed to unearth anything which contradicts the claim that 'innovation would be enhanced, not hindered, by opening the DDS interconnect field to more competition.' In fact, we believe that a promising future strategy for high-performance service at the least cost is to open all customer premise equipments, including the CSU and all other network channel terminating devices, such as those used for DDS or any other service, analog or digital, to competition... 3. The performance standards for DDS or any other network, analog or digital, can be met equally well and possibly better with registered equipment constructed

to realistic specifications and provided on a competitive basis (35).

Because of these controversies, the Notice of Inquiry was taken seriously. Comments were filed by 34 parties, many of which had never participated in formal ISDN activities before. In parallel, attendance at Department of State-sponsored advisory committee meetings increased and broadened significantly. Based on input received in the comments, the FCC announced its conclusions in its March 30, 1984 First Report in the matter of ISDN.

The First Report repeated the Commission's intent to limit its role in ISDN. However, it did state several principles that it believed were important to consider in the design of ISDN for the U.S. environment. The one that the FCC seemed to emphasize most was that the CCITT recommendations must be sufficiently flexible to accommodate the principles of the Computer Inquiry II, i.e. basic/enhanced dichotomy.

The Commission further emphasized the need for detailed U.S. planning to proceed in an open manner in which equal participation can be expected and in which the text of any proposals would be available prior to discussion and approval. The Advisory Committee Act and antitrust legislation naturally encourage such openness (37).

The Commission made it clear that routine appeals from those which were not satisfied with decisions of the USCCITT would not be accepted. If its general guidance was not being followed, however, the Commission would consider its option under Executive Order 12046 to advise the Secretary of State directly. Under this order, "the Secretary of State shall coordinate with other agencies as appropriate, and in particular, shall give full consideration to the Federal Communication Commission's regulatory and policy responsibility in this area" (38).

Michael J. Marcus, chief of the Technical Analysis Division at the FCC discusses the change of the FCC's role. He noted that traditionally, the FCC has had almost no role in the technical aspect of CCITT, as opposed to the tariff implication. The FCC, however, increased its involvement with the CCITT because of a shift in the role of the Committee. In the past, the CCITT had concentrated on developing technical standards and operational procedures to facilitate the interconnection of national communications networks. But some of the recent CCITT activities indicate an increased interaction between the CCITT and the design of the basic structure of the U.S. communications industry. He comments on the implications of this change:

> Such interaction will have many clearly positive benefits to the United States such as facilitating exports of equipment. However, since only two other countries out of 159 members of the International Telecommunication Union (ITU) have any aspect of competition in their carrier industry, decisions made in this forum have a tendency to be biased toward monopoly. This is not to imply that other countries seek to impose their industry structure on the United States intentionally; rather they are focusing on their own situations and honestly do not understand the implications of the U.S. industry structure (39).

Other actors playing a significant role in shaping the development of ISDN in the U.S. context, are the public network carriers, i.e. AT&T, Regional Bell Operating Companies, and equipment manufacturers, such as IBM. AT&T had a dominant role in the planning of U.S. participation in CCITT as well as USCCITT (40).

4. AT&T and the Regional Bell Operating Companies - Even though AT&T is a private entity, its historical control over the U.S. telephone network provides the firm with an incentive much like that of the PTT's to promote a monopolistic ISDN. As the FCC admitted, however, several ISDNs could emerge from existing privately owned telecommunication networks due to the presence of bypass networks. Actions taken by the FCC with regard to ISDN can be seen as the result of efforts by business users and equipment companies who want to maintain those private networks and eventually construct a bypass version of ISDNs (41). To counter this move AT&T and RBOCs are trying to develop ISDN as fast as possible.

The first announcement of an ISDN trial was made early in 1984 by Illinois Bell. This trial will provide ISDN basic access capabilities to an Illinois Bell Custom Centrex facility using an AT&T 5ESS digital switch. Services to the customer is planned to begin in the second half of 1986. A spokesman for AT&T stated that regardless of the trial outcome, which he expects to be successful, the company intends to make the service generally available in 1987 (42). AT&T Communications Inc., Nynex Corporation, Pacific Bell and Mountain Bell's trial plans followed the Illinois Bell's (43).

5. IBM - IBM's position is still unclear. IBM has generally endorsed the ISDN concept. It has also launched the services through its exsubsidiary, Satellite Business Systems, as one of the first commercial ISDN services. IBM, however, has long been known for endorsing a standard and then delivering support reluctantly. For example, IBM endorses the International Standard Organization's Open System Interconnect (OSI) model, but has done little to deliver support outside the European market. Also, IBM has endorsed X.25, but is marketing Systems Network Architecture (SNA) as an alternative standard (44). According to a recent interview with an IBM executive, it was indicated that SNA will not evolve into developing standards for ISDN but will grow to support ISDN. IBM intends to get users involved in the CCITT efforts to standardize ISDN as well as in the International Standards Organization Open System Interconnection (OSI) Basic Reference Model development, since it feels network

providers are dominating the agenda of both the CCITT and ISO. The executive pledged stronger participation of IBM in those international fora, particularly through cooperation with its large user groups. He stated:

> We'd like to see ISDN offerings have a common set of standards country to country, and avoid the implementation problems that developed with X.25,where although we have a worldwide standard, country to country, it's been implemented differently. We would like to see ISDN developed with more uniformity across the world. We think ISDN will be more successful if customers participate in the standard activity" (45).

The way IBM participates in the standardization process has a critical importance particularly in one aspect - intelligence of ISDNs. If public ISDNs have a high degree of intelligence within the networks, they will provide a range of value-added communications capabilities, hence threatening the position of companies such as IBM. The issue of network intelligence will be discussed in a later section. Also, how IBM counters AT&T's and RBOC's dominance in ISDN planning will remain to be seen, especially IBM's new alliance with Microwave Communications Inc. (MCI).

IV. U.S. Telecommunications Policy Environment

U.S. policy for the telecommunications industry has been implemented through interactions among the courts, the Federal Communications Commission (FCC), the Public Utility Commissions, and private companies, the major one being AT&T. In the last several years, it has increasingly relied on the principles and dynamics of a competitive market in lieu of rules and regulations established by the former three actors just mentioned. This has led to continuing growth of competition in supplying equipment and services, encouraged by three major events in the regulatory sphere (46).

First, with the advent of the computer, its applications to telecommunications were developed in the 1960's. Consequently, large numbers of non-telephony firms obtained technical expertise that was directly transferable to communications. At the same time, telephone companies were also developing computer processing expertise. In the midst of the marriage of computer and communications technologies, the FCC recognized regulatory imbalance in which the telecommunications industry was held while the computer industry was not, and instituted Computer Inquiry I in 1966 (47).

Secondly, after five years of consideration, the FCC classified communication services in four categories: (1) data processing, (2) hybrid data processing, (3) hybrid communications and (4) communications. These 1971 rules decided little. They left too many ambiguities and were phased out (48). In 1980, in its ruling in Computer Inquiry II, the FCC distinguished "basic" telecommunications services from "enhanced" services. The former was defined as involving the mere carriage of information from one point to another without any transformation and the latter was characterized as involving the storage and processing of customer information, the conversion of customer codes and protocols, and value-added processing. This ruling was a clear move toward deregulation. All terminal equipment, including plain old telephones, was to be deregulated as of March 1982. After that time, terminal equipment could only be provided by AT&T and GTE through a separate unregulated subsidiary, not as part of the basic telephone service. In addition, they were allowed to offer enhanced services only through a separate subsidiary so they would not have a preemptive advantage over their prospective competitors (49).

The third event that led to the growth of competition was the agreement reached between AT&T and the U.S. Department of Justice in January 1982, which was called "the Modification of Final Judgement" (MFJ). It prescribed the divestiture of AT&T into seven Regional Holding Companies. Those companies were to provide exchange services and exchange access services through the 20 Bell Operating Companies. In return, AT&T was allowed to enter freely into all telecommunications and non-telecommunications services through its fully separated subsidiaries. The Regional Holding Companies are limited to provide only local service, within defined geographical areas known as Local Access Transport Areas (LATAs). The seven companies may provide terminal equipment but independently of their tariffed service offerings.

These three major events have played an influential role on the development of ISDN architecture principles in the U.S. so far (50). However, the newest FCC tactic for further deregulation is on the move. Implementing Computer Inquiry II ruling, the FCC had judged whether services are basic or enhanced, case by case (51). Also, there have been various waiver petitions filed by AT&T and BOCs which have been prevented from offering services with advanced technologies.

These complications would be eased by Computer Inquiry III, which was outlined in late July of 1985 in a Notice of Proposed Rulemaking. More importantly, new rules, if enacted, would make it easier for carriers to offer, along with basic voice signal transmission, enhanced services such as ISDN and protocol conversion. Therefore, this will lead to expedition of ISDN implementation (52).

V. The Japanese INS and Japanese Telecommunication Policy

As stated earlier, the equivalent of ISDN is called INS (Information Network System). The difference between the two did not end only in acronym. INS was not merely one company's product to meet the future, but rather it is a national plan to create an innovative infrastructure involving an efficient integration of the various networks. Thus it includes not only terrestrial telephone networks, but satellites, new computers and mobil communications for automobiles, airplanes, ships, etc (53).

The fundamental features of INS are based, however, on the CCITT definition of ISDN and most of the existing technical differences will be modified after the CCITT's final recommendation which will be made in 1988. The principal architect of INS is Dr. Yasusada Kitahara, Executive Vice President of NTT. At the time of INS conception, late 1970's, NTT's monopoly on communications industry was taken for granted and it underlies all aspect of INS planning. Therefore, it was created as a national plan, as it is true in many West European countries. INS plan was neither an engineer's dream-come-true nor advanced-information-society advocate's ramblings. In a way, it was a logical step for Kitahara to conceive the plan for digital network(s) all across the nation after NTT implemented universal service by meeting all the unsatisfied demand in telephone services, and completing a nation-wide long-distance direct dialing system. NTT, being a monopoly at the time of INS announcement in 1981, could gain much economic efficiencies by integrating all six existing public networks - telephone, telex, data communications, telegraph, facsimile, and video (Figure 1) (54).

Naturally, the privatization of NTT changed the notion of INS with all the competitors at work. It is now considered as an ISDN offered by the new NTT.

To evaluate INS implementation in Japan, it is imperative to familiarize oneself with the current regulatory environment. NTT has operated as a monopolistic entity in the domestic telephony industry since 1952 suceeding 70 years of a government ministry monopoly. International telecommunication has been in the sole hands of the Kokusai Denshin Denwa Co., (KDD) since 1953, which interconnects with NTT at international gateways. However, in contrast to AT&T, which has fought hard to keep control of Western Electric, its supplier, NTT has never made its own equipment. Indeed, ever since its foundation, procurement of cables, switching devices, computer equipment and telephones has been done by nurturing a few large companies of the 'Den Den family.' These firms; Fujitsu, NEC Corporation, Hitachi, Oki Electric, and recently Toshiba Inc., benefitted not only from a protected market (as no foreign firms were allowed to sell to NTT until 1981), but also from the development-oriented research being done in NTT's Electric Communication Laboratories where much of Japan's best research on electronics is conducted.

With regard to patents held by its research laboratories, steps to promote the company's licenses abroad are being considered. While the policy of cultivating the large communication-equipment firms was seen as a prudent and successful policy during NTT's first two dozen or so years, strict regulation and minimal competition meant that the protected environment did not always serve the needs of the consumers and did not stimulate technological innovation outside NTT's supply umbrella (55).

The Ministry of Posts and Telecommunications (MPT) has most direct administrative responsibility for telecommunications. It also oversees postal services and broadcasting. However, with the convergence of computers and telecommunication technologies, the scope of MPT's responsibilities and interests has widened and has transgressed upon the Ministry of International Trade and Industry's traditional domains which deal with the development of the computer and electronics industries (56). This is most prominently observed with the deregulation of value-added network (VAN) services in which computer technologies are closely integrated into the telecommunications network. MITI has insisted on the elimination of regulation by MPT which, so far, has not materialized.

There have been many other factors, domestic and international, that made NTT privatization a reality following the restructuring of British Telecom and the breakup of AT&T. They range from the various recommendations from distinguished committees and governmental reform councils, such as the Administrative Reforms Ad Hoc Committee and the powerful Keidanren (The Federation of Japanese Economic Organizations) to international pressures mainly from American companies and government officials (57).

With a realization that NTT can no longer operate in a protected vacuum, both Houses of Japan's Diet passed a set of three bills - The Telecommunication Enterprise Act, the NTT Privatization Act, and the Omnibus Act - aimed at remodelling the nation's telecommunication industry. This transformation consists of the privatization of NTT, and the entry of private carriers and value-added networks. In particular, the bills are expected to open the market to foreign suppliers of value-added services.

The Telecommunication Enterprise Act established two classes of companies. 1) Category I carriers which operate their own communication facilities, providing basic telephone services, and which will have to be licensed by the MPT, 2) Category II carriers that will lease facilities from the former. There exists very few restrictions for their operation. Category II carriers are further classified into two categories: 1) Special Category II carriers which provide domestic telecommunications services of larger scale than the standard set by the MPT and international services (after agreements with the International Telecommunication Union are modified in the future) and 2) General Category II carriers which consist of all other carriers not falling within the other categories.

Whereas Category II is open to foreign services suppliers, Category I is restricted to companies with no more than one-third foreign ownership (58). In other words, a dichotomy exists in this new law between line-owned and line-not-owned. And both categories are permitted to offer both basic and enhanced services which makes quite a contrast with the U.S.

It is not clear however, what the competitive relationship would be between Category II carriers which lease NTT circuits and NTT if the latter should start its own sophisticated communication services. This increases some uncertainties about the implementation of INS.

The NTT Law mandates the transfer of NTT from a public corporation to a private corporation, and heretofore, NTT will be called Nippon Telegraph and Telephone Corporation. In contrast to AT&T, it has not been divested, even though there has been suggestions to do so. Due to this factor, Article 2 of the supplementary Provisions of the NTT Law requires that the government reviews the operation of the new company within five years after the enactment of the law in order to assess appropriateness of NTT divestiture (59).

Despite the private company status, NTT has an obligation to offer universal service as regard to basic telephone services as stated in Article 2 of the NTT Law:

> The Company shall ... give consideration to the maintenance of its proper and efficient management and shall contribute to the securement of provision of stable nationwide telephone services throughout Japan by providing such services indispensable to the people's life at appropriate conditions and impartially (60).

This provision raises the question of how NTT will implement INS as far as offering services with a reasonable rate to residential users who are likely to need only voice communication. This will be discussed later in more detail. Another question raised by this provision is: 'Will NTT be left with required maintenance of unprofitable services to the hinterlands while the new entrants grab pieces of the lucrative beltways of telecommunications along the Tokyo-to-Osaka-and-beyond line?' (61).

The new NTT is authorized to provide exchange and interexchange services as well as enhanced services such as data-communications. This indicates, unlike AT&T/BOC split, that NTT is allowed to use the common facilities for all services; however, strict measures will be taken to ensure that NTT does not cross-subsidize the exchange and interexchange services, in order not to impede competition. The government will always hold a certain percentage of stock issues by the new NTT - 50% until the government's review on the new company's operation required by the NTT Law which will likely to be held in 1990, and one-third of the shares thereafter (62).

There is obvious contradictions between the INS concept created in a monopolistic environment and competition spurred by the NTT privatization. The INS will likely face similar issues and problems vigorously debated with regard to ISDNs in the U.S. A problem most likely to occur would be, as stated earlier, the effect of competitive relationship between new entrants and NTT, i.e., new entrants might curtail NTT's efforts to implement universal services and INS. Observing the behavior of NTT's competitors, it is almost certain that there will be more than two ISDNs in Japan some time around the turn of the century. If that is the case, how will they be interconnected?

Unless compatibility can be achieved through protocol conversion, competition on ISDNs in Japan will occur among Category I businesses that are capable of constructing their own integrated facilities including VANs. On the other hand, Category II businesses will not be able to provide value-added services to various end users with incompatible terminals. One author notes that the development and adoption of system software, which allows communication between incompatible terminals, has to be a high priority if different VANs are to compete. Without such compatibility, the dominant carrier, NTT, which already has assembled such an integrated network through its INS project, will have the greatest advantage. This is the focal point of an interbureaucratic conflict between MITI and MPT. Thus, further clarification of the INS concept will be called for (63).

VI. Technical issues surrounding the standardization of ISDN

In this section, technical aspects of ISDN standardization will be discussed. Non-technical issues will be covered in a later section.

The standardization becomes more important than ever with the advent of advanced technologies. For example, with portability of subscriber terminals, ISDN compatible equipments and operations are essential not only domestically, but internationally.

Considering the many factors going against the standardization activity of the CCITT, the Committee has made great progress in reaching agreements on a variety of issues. However, there are some technical decisions that still need to be reached before ISDN becomes compatible worldwide. First, nations support different methods for basic access transmission. In Europe and the U.S. echo cancellation technique is recommended. U.S. chip manufacturers in particular are strong supporters of this method because their profit is at stake. Others in the U.S. as well as Japan recommend time-compression multiplexing because they believe it is a better technique to accomplish the same task. In fact, it has been reported that NTT would like to adopt this technical system even though the final CCITT recommendation in 1988 may turn out otherwise (64).

Another technical issue which should be agreed upon concerns channel transmission speed. A consensus seems more difficult to reach since

Europe, the U.S. and Japan want to adopt different systems for user/network interfaces.

Europe has chosen to adopt 64 KB/s for 2Bs (two basic rates), with all 64 kilobits available for user data transmission. In the U.S. some Bell Operating Companies, AT&T Communications, and AT&T Technologies which announced the plan for running ISDN trials decided to adopt 64 Kb/s as their basic rate for transmission speed (65). However, there is a strong feeling that 56 Kb/s, as used by Pacific Bell for its trial, will be the definite choice (66).

To make things more complex, NTT who has been the sole Japanese entity to have developed INS, adopted in 1984 an interface of 64 Kb/s and 16 Kb/s (equivalent of 2 Bs) each accompanied by a 4 Kb/s (functions as 2 Ds) in order to launch the 1984 INS model system, an experimental operation (67). NTT, however, is planning to modify the interface protocols after the final CCITT recommendation will be made in 1988 (68). While alternate ISDN standards may coexist awaiting for marketplace determination, the long-term effect of incompatible ISDN systems is one of the biggest concerns.

VII. Considerations for the development of ISDN

In order, for the benefits of ISDN, to materialize, certain elements have to be taken into consideration.

1. Safeguard against rapid obsolescence - The standard selection for implementation of technologies must be evaluated so as to ensure that they have sufficiently wide time spans for effectiveness; otherwise premature obsolescence will occur (69).

2. Overlay facilities and networks - The communications needs of the business users are becoming significantly different from those of the residential users, overlay fiber-optic and packet-switched facilities will be required to meet the service demands of the business users, in particular (70).

3. Digital vs. analog effectiveness - While a long-term commitment to all digital networks is important, premature conversion to a digital solution in the face of more efficient analog alternatives will hurt the competitiveness of the ISDN-delivered services and impact negatively on its future development. The use of analog transmission for full-motion video, compared with its digital transmission is an example where digital technology has not yet met the criteria for cost effectiveness (71).

4. Role of satellite - There have been some concerns in the U.S. that CCITT will discriminate against satellite systems, because the forum is mostly composed of terrestrial network providers. In response to that the FCC, in its First Report on ISDN, referred to satellite facilities saying:

> ...We conclude that to the extent that there may be differences, users should have the opportunity to choose the service attributes they require, without being foreclosed from making such a choice. A similar principle should apply in the case of ISDN (72).

In Japan, satellite routing for INS is still a concept not a reality. NTT is considering the launching of a satellite for INS, however, with domestic aerospace technology which is far behind the U.S. counterpart. Therefore, it is believed to be uneconomical to do so in the near future, unless NTT can develop high capacity in circuit transmission - i.e., 100,000 to 200,000 voice circuits (73). This may change if NTT decides to purchase satellites from the U.S. under the pressure from the U.S. adminstration.

5. User awareness of ISDN - In the U.S., a wide range of ISDN-related knowledge and planning activities exist among potential suppliers of ISDN-compatible hardwares and services. According to a Venture Development research finding, only 9% of data terminal manufacturers have ever heard of ISDNs. Consequently, none of them has begun any such product planning. This has a negative implication for the development of the system, because data terminals will be among the most common means of access to ISDN (74).

On the other hand, PBX manufacturers are the most knowledgeable among future ISDN-hardware producers, and reportedly, 88 percent of this group is already incorporating ISDN standards into their product planning. But most of all, network providers, especially telephone companies, are most enthusiastic and even call ISDN the public switched network contender against all other alternatives. With all the competitive forces at work and threat of bypass, ISDN is essential for them to enhance network capability in order to retain customers (75).

Japan is somewhat ahead of many other OECD countries in terms of ISDN planning. The experiment with INS model system has started in September, 1984 in Tokyo suburbs to increase public awareness, among other objectives. Two thousand subscribers were selected by NTT to use and monitor INS services free of charge for 6 years. A substantial difference from the U.S. ISDN experiments currently planned can be observed in INS model system operation, i.e. 64% of the monitors are residential users (29% business users, and retail establishments, 7%). In the U.S., all the ISDN trials are aimed at corporate users, at least in the near future, which totally alienates residential users. This can be attributed to NTT's dominance and its ex-public corporation status, just as some European countries are planning the experiments through PTTs (Ministries of Posts, Telegraph and Telephone). This helps to promote users' awareness both residential and business (76).

6. User needs - There have been sceptics who feel that ISDN is being "technology driven" rather than

provided to meet a real market need (77). This seems to be a legitimate concern. While the technical issues are being debated in international standards committees and other technical fora, there has been little public consideration and debate of the user aspects of ISDN. Customer opinion and influence are inescapable: the survival of products and services ultimately depends on those who are able and willing to pay for them. Users will only migrate to ISDN when the network services: 1) become available in a sufficient number of locations; 2) are proven to meet suitable performance objectives; 3) have acceptable pricing structures (78).

Then who will be the most likely users of ISDN in the foreseeable future? From banks to airline companies, multi-national telecommunication users plan and do business all over the world. Their demand for telecommunications are spurred by a growing competitive need to reduce costs, as corporate dependence on information systems continues to escalate. One author notes that telecommunications have become the second largest expense, amounting to hundreds of millions of dollars every year at Citibank. In this environment, ISDN can contribute substantially to reduce soaring telecommunications costs of those multinational corporations (MNCs) in using an integrated voice, data and video system, previously in separate networks (79).

In Japan, even though the residential users' awareness toward INS might be higher than counterparts in the U.S., the fact remains that network providers still have to depend substantially on the needs of business users. One of the main reasons for this is the cost of the new terminal equipment to be connected to INS. The most likely terminal equipment that residential users need will be digital telephones. According to one estimate, digital telephones will probably cost $120 - $160 with current technologies, even if manufacturers can take advantage of economies of scale. Unless there is drastic increases in demand for data communications, facsimile, and videotex, this increase in the telephone price cannot be absorbed (80).

There is a little over 42 million telephone stations in use in Japan. Thirty million are residential and 12 million are business. The residential users can be classified in three different categories. 1) Users who only pay the basic rate and rarely use telephone - (approximately 10 million); 2) Users who pay between $20-$25 a month (15 million); 3) Users who pay more than $40 a month (5 million). NTT estimated 12 million business units and 5 million residential units, which are using telephone services for more than $40 worth per month, as potential users of digital telephones. Also NTT forecast that 7 million units will migrate to digital telephone by the year 1992 and 20 million units will migrate to digital by the year 1997 (81).

7. Private leased circuits - The provision of the equivalent of a private leased circuit is a key user requirement. A private leased circuit is defined as a facility which has a predictable performance, no connection set-up and continuous availability (82). While permanent switched connections may be one method of substituting a leased circuit, it is not clear that this will satisfy all user requirements, e.g. multipoint configurations. Therefore, private circuit lines are essential for many business users to meet their technical needs, particularly as they relate to performance, security and reliability (83).

Despite the positive aspect of ISDN, many MNCs have serious doubts about the development of these all-digital networks, particularly that of Europe. The International Telecommunications User Group (INTUG) representing numerous MNCs argue that once networks have been fully converted to multi-function digital systems, they will operate with all the sophisticated services, such as enhanced or value-added, substituting a private leased circuit now in use. They also said, this is precisely why European PTTs are working as fast as they can to develop ISDN, so as to maintain their monopolies. These claims are made in reaction to specific events recently taking place in Western Europe.

In 1983 West Germany's PTT, Deutsche Bundespost stunned many large European corporations by modifying its tariff structure in preparation for the digital network, which it plans to begin operation by 1987. Later this year the Bundespost will charge companies with leased lines according to the amount of traffic they send over those lines, instead of the flat rates they now pay (84). Users calculated that this could increase the cost of transmitting data by as much as 700%, making many current operations uneconomical to maintain (85). The user group also fears that the West German effort to move their traffic from private leased lines to the public switched network could spread to other European nations, raising rates and jeopardizing control and privacy of their communications abroad (86). The Bundespost says the tariff change is necessary to protect its investments in the public networks. Otherwise, large companies will use private leased lines for the bulk of their traffic and send only the occasional overflow via public networks. This kind of "creamskimming," it says, would put the Deutsche Bundespost at a great disadvantage.

User groups, as well as the International Chamber of Commerce, argue that they still need affordable private lines because the PTTs are ill-equipped to satisfy demands for new services. In the long run, the Chamber feels, a competitive environment would not only best serve users but also increase the volume of communications, which would provide the PTTs with more revenues from their networks. Breaking the PTT monopolies, the users argue, is also necessary if they are to get the most up-to-date information processing equipment. Many have stated that European suppliers suffer from enormous technological lag, and the reason is their close links to the national PTTs (87).

8. Intelligence within the network - It is important to consider the benefits of including various levels of intelligence in the design of ISDN, i.e. value-added services, since an intelligent network, as opposed to a transparent network, places constraints on users of the network (88).

Among industrialized nations which are planning ISDNs, there is conflicting interests - that of network providers and users, especially business users. Much debate has been taking place as to how much value-added functions should be in the network and how much on the user premises. One representative of INTUG noted that placing ISDN intelligence within the network is an intrusion in users' legitimate freedom of terminal choice and operation (89).

In Japan, after the NTT privatization last April, other carriers are allowed to offer value-added networks (VANs) as well. Consequently, they are preparing the facilities to offer them. NTT, of course, is not standstill. It has already been offering several value-added services, and tries to include as much intelligence as possible within their networks.

Questions raised here relate to how the structure of VANs offered by the Category II carriers will mesh with the concept of an NTT-based INS. It is uncertain whether the protocol conversion and different systems for format capability will be within outside INS. If the functions are to be located within the network, competitive service suppliers of VANs will not be able to achieve any cost - or technical - advantages (90). The concept of INS operation should be defined in more detail.

9. Tariff implications - The issue of determining tariffs for ISDN services is presently left blank. Since all transmissions on a ISDN is to be digital, there is a question in the U.S. presently under study by the FCC regarding the fairness of charging for various ISDN services equally. A simple message, for example, could be sent by telex, facsimile, or voice. The telex message would probably require the fewest bits for transmission completion. Facsimile most likely would use more bits and voice transmission the most bits to transmit the identical message (91).

The voice transmission would, therefore, be the most expensive method and telex the least, if it is charged by per-bit. This is a sticking point, since different groups of users want to protect their own interests. Nicholas Derek of INTUG, emphasizes the need of business users:

> A common objective in the establishment of a price structure should be to avoid discriminating against any class of users. Cross-subsidizing between various services should be minimized, and pricing for services should be related to the costs and provision of services wherever possible. Above all, the principles of pricing should be known and any cost interaction clearly indicated. In the formative years of the ISDN, costs and price ratios may need to be adjusted to encourage users to migrate to the new facilities (92).

Furthermore, the Venture Development's market research reveals, as might have been expected, that prospective users will be interested in migrating to ISDN only if it cuts their communications costs. An average of almost 40% of corporate telecommunications managers' annual budgets are presently allocated to voice communications services. These managers are doing everything to reduce costs. Thus, they view ISDN as a new solution to existing problems. If ISDN proves to be more expensive than current charges, then, amidst of telecommunication deregulation, every user will find his/her own unique solution, thereby wasting years of standardization work (93).

Representatives of residential users view the issue of ISDN tariffs somewhat differently. It has been perceived that discussions of the digital network have never been centered on probably benefits to telephone users despite the fact that the telephone network will continue to play a vital role in society. It may be argued that considerable cost reduction would result from digitization of networks. However, it is claimed that it may rather apply to data communication users, since the amount of data to be carried per second on a telephone circuit will increase from some 4.8 kbit/s to 64 kbit/s. Residential users would like to see the definitive advantages of ISDN be demonstrated to them; some telephone subscribers do not need or want non-telephone services (94).

10. Threat of bypass - In the U.S., it has been said that high levels of bypass activity could slow the Regional Bell Operating Companies' efforts to develop or market ISDN-related products and services in some markets. If a telecommunication manager is compelled to choose between bypass and ISDN, his/her choice might depend on the relative costs of each option (95). This is a threatening notion for public network providers in the U.S. because bypass networks already have existed at every level, from local loop to 'global grid'. Private development of digital networks by MNCs are also on the way. In another word, they are trying to construct a private version of ISDN worldwide. It is for this very reason that MNCs become increasingly vocal on the issue of keeping private leased lines (96).

VIII. International Trade

One aspect of ISDN development in the U.S. could be uncontrolled market structure for international trade. Is the United States well prepared to compete with others in ISDN-related equipment and software exports? Although all suppliers of subscriber equipment face the same challenges when exporting products, such as PABXs (Private Automatic Branch Exchanges), digital switching and transmission equipment, optical fibers, software, terminals, etc., the European and Japanese companies certainly have a head start. Many have been selling in the international arena for decades and understand the intricacies of dealing with the PTTs much better than do North American companies. L.M. Ericsson, for example, gets 95% of its sales outside of its own country and already has orders from 20 countries for its new digital PABXs. By contrast, American Telephone & Telegraph Company (AT&T) captures less than 5% of its equipment sales outside the U.S. (97).

However, what U.S. and Canadian telecommunications suppliers may lack in international experience, they make up for in technology. Rolm and Northern Telecom both have state-of-the-art, fully digital PBXs, and they are eyeing on overseas markets.

Many U.S. equipment makers are looking for overseas partners to guide them in their dealings with the PTTs and be familiar with local market requirements. One U.S. telecommunication executive was quoted as saying "Our partners need to be technically astute in order to assist us in adapting our equipment to the local country. And they need to be politically astute." Even AT&T has formed a joint venture with Dutch-based Philips for selling equipment to European countries (98).

It takes time and dedicated efforts to be familiar with indigenous conditions and be successful in overseas markets. Joint ventures with foreign companies might not be enough to overcome the barriers. When exporting to developing countries where local manufacturing is mandatory, such as Brazil and India, government involvement in export contracts become very important. For example, Japanese MITI (Ministry of International Trade and Industry) has been quite instrumental for many Japanese manufacturers in this area. In more general terms, coordination between PTTs and other sectors of government, manily departments of commerce and/or industry has been established to stimulate telecommunications and other industries, and assist them in international business transactions (99).

Many authors pointed out the lack of coordination and short-sightedness in the policy conducted by U.S. government agencies in regard to telecommunication. A recent example demonstrates this point. When AT&T divestitute was a subject of vigorous discussion in judicial and legislative circles of the government, supporters of the AT&T reorganization were so concerned with domestic antitrust arguments, they simply did not fully consider the international trade implications. As a result, AT&T breakup created a huge, unregulated market accessible to foreign telecommunications equipment suppliers. Japanese manufacturers benefitted most from this policy misstep.

According to Senator Danforth, the breakup of AT&T would open a new $5 billion market in the U.S. Another study estimated Japan's share of the U.S. telecommunication equipment market by 1990 at 42% and Canada's at 23%. If more coordination and/or supervision had existed in the government sector, the current situation could have been avoided (100).

If the incompatibility of CCITT standards and FCC rulings regarding the partition between the public network and consumer premises equipment continues to exist well into the future, the U.S. manufacturers of ISND-related equipment and software will most likely be negatively affected. For they will not be able to take advantage of economies of scale in producing their products, since two different model specifications have to be maintained.

IX. Conclusion

Many parties are actively shaping ISDN; international standards bodies, public and private network operators, equipment designers, manufacturers, and users.

In various ways the U.S. continues to move in a direction completely opposite from ISDN concepts. While the international community is moving towards an integrated system, the U.S. is becoming even more entrenched in a dichotomy of enhanced/basic telecommunication services where "integrated" can have possibly a negative connotation. Not only does the regulatory split between enhanced and basic services contravene the principles of an ISDN, but the multiple-carrier pro-competitive U.S. philosophy presents many questions as to how the American telecommunications market would fit into the ISDN system.

Differences between the U.S. economic and regulatory system and other nations were highlighted at a 1983 meeting of a CCITT study group on tariff principles held in Geneva. A Japanese representative pointed out that an ISDN would be based on digital technology, therefore, creating the condition for a "marriage" of communications and computer capabilities and offer a variety of teleprocessing services. The chief U.S. delegate, Earl Barbely, cautioned that computers and communication would have to be kept separate in the U.S. because of the Computer Inquiry II (101). This, however, might be changed by the forthcoming Computer Inquiry III.

The final implementation of the ISDN will be much more difficult in the U.S. than in the rest of the world. This is due primarily to increased proliferation of interim solutions or pre ISDN concepts and private networks. The problem is the compatibility, not only in performance but also when dissimilar techniques are used in the line and network interfaces. As additional investments are made with a particular standard, achieving compatability becomes more remote. The same can be said across nations. As pointed out earlier, the U.S. and Japan as well as Europe, in some cases, want to adopt or have already adopted different specifications for the user/network interface.

In the midst of trade imbalance there is a concern among Japanese political circles that these differences might worsen the frictions because it has a far-reaching impact on the introduction of U.S.-made switching and terminal equipment into the Japanese market. This is one of the reasons why NTT will change channel transmission speed of user/

network interface by 1990 to match that of the CCITT recommendations. By this action, NTT will waste much of the initial investment, since it will start INS commercial services in Tokyo, Osaka and Nagoya at the end of 1985, and in other major cities beginning 1987 with the present specifications (102).

The United States, Japan and other countries should endeavor to promote a minimum of standards established at CCITT defining access to an ISDN and its functional performance characteristics. This will maximize freedom of action in developing and manufacturing ISDN-related equipment to meet the requirements of diversified users in each country. As the director of the CCITT suggested, a "synergetic" approach is essential for the sound evolutuion of the ISDN. The main thrust of this approach is to solve issues which can be agreed on, while leaving the other issues blank as long as no consensus exists. Standardization of the ISDN must, therefore, be open-ended and have a long-term perspective for completion (103).

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U.S. POLICY INITIATIVES
ON INTEGRATED SERVICES DIGITAL NETWORKS

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Abstract

The Federal Communications Commission ("FCC") will regulate Integrated Services Digital Networks ("ISDNs") from a flexible, domestic marketplace orientation. The Commission's primary objectives will be to promote competition and open access to the technological innovations represented by ISDNs. Such a policy agenda, most recently outlined in the *Second* and *Third Computer Inquiries*, does not completely jibe with what international forums and foreign countries seek. Accordingly, the mutual goal of internationally ubiquitous and interconnected ISDNs, requires coordination and compromise. The FCC must adopt domestic policies, which have international implications, with an appreciation for international comity and the need for universal operating formats. Without abandoning its advocacy for domestically minded policies, the FCC must acknowledge fundamental economic and industrial structure differences with foreign nations and devise a method for making accommodations.

INTRODUCTION

The Federal Communications Commission ("FCC") acknowledges that Integrated Services Digital Networks ("ISDN") (1) "will emerge from existing telecommunications networks and represent the next stage in the evolution of telecommunications." (2) As such, "the FCC has an institutional interest in the ISDN planning process, because the results may be subject to the regulatory process in the future, and because it is possible at an early stage to seek to ensure that the planning incorporates sufficient flexibility to accommodate important United States telecommunications policies." (3)

At the onset of ISDN technological development, matters of regulatory policy, economics and industrial structure become inextricably involved. If ISDN is to become, as anticipated the flexible and ubiquitous network capable of transmitting any kind of telecommunications or information processing service, nations must agree to universal and operational standards. This task becomes difficult when national domestic policies are deemed desirable for international application without consideration whether modification is warranted.

The FCC's domestic telecommunications policy agenda does not completely jibe with what international forums and foreign countries seek. While most countries consolidate telecommunications offerings under the aegis of a government post, telegraph, and telephone ("PTT") authority or franchisee, often charged with pro-social, but non-remunerative service obligations, the United States telecommunications marketplace is characterized by growing competition, among multiple and diverse service providers, substantially freed of intrusive or burdensome regulation.

U.S. telecommunications policy makers are committed to eliminating arbitrary, anachronistic or dysfunctional international service limitations. (4) In many instances, they seek to apply internationally, domestic initiatives that have enhanced the public welfare by fostering competition, deregulation, diversity and downward pressure on rates. However, marketplace successes achieved in the United States through procompetitive, deregulatory policies may not accrue similar benefits in the international arena. Nevertheless, the FCC appears intent on advocating the international acceptance of its domestically minded ISDN policies"

> "U.S. ISDNs must evolve under a structure which accommodates our multiple vendor telecommunications market and our procompetitive policies. Our regulatory framework is sufficiently flexible to permit existing carriers and enhanced service providers the ability to develop ISDN configurations with minimal additional capital investment and disruption of service ...." (5) Accordingly, "[t]he most practical approach to planning an ISDN model would seem to be one that accommodates the interests of U.S. telecommunications service providers, equipment manufacturers and users during the international planning phase." (6)

ISDN AND FCC POLICY

Notwithstanding clear advocacy for domestically minded policies, the FCC supports uniformity in ISDN interface characteristics to "permit national ISDNs to interconnect and form a world-wide system or systems ... [thereby] promot[ing] ubiquity of technical equipment used therein." (7) This laudable promotion of standardization raises questions about ISDN interconnection of customer premises equipment ("CPE"), interfaces, system interconnection, ISDN protocols and other operational issues. On a broader front, it calls into question how the FCC's actions will affect international standard setting forums and whether the Commission can persuade nations to plan for multiple ISDNs and maximum flexibility, from a consumer oriented, procompetitive foundation.

THE SECOND AND THIRD COMPUTER INQUIRIES

The FCC fully expects international ISDNs to accommodate its broad regulatory campaign to:

- o deregulate customer premises equipment and not regulate information processing, including some enhancements to basic transmission capacity likely to be incorporated within an ISDN; (8)
- o apply a degree of structural separation, or accounting and operational constraints between common carrier basic telecommunications services and other enhanced offerings;
- o foster market segmentation primarily for purposes of applying varying levels of regulatory oversight, reduced to the least degree of intrusiveness sufficient to prevent dominant carrier anticompetitive practices, while also securing open access and network transparency for customer-tailored use of CPE and private lines; and
- o promote robust ISDN diversity, accessibility and flexibility, notwithstanding indications that foreign ISDN development will be characterized by singularity, restricted access, limited options, and controlled deployment of digital services.

The FCC's Computer Inquiries attempt to use service definitions as the basis for determining how to regulate and structure the telecommunications/information processing marketplace. The Second Computer Inquiry's basic/enhanced services dichotomy sought to foster a distinction between what regulated common carriers provide, and what others, including carrier subsidiaries, can offer on an unregulated basis, having acquired the transmission capacity building block from a carrier pursuant to tariff. The Commission ordered structural separation, by requiring a CPE and enhanced service subsidiary to deal at arm's length with its basic transmission capacity supplying affiliate. The Third Computer Inquiry proposes to use a trio of service categories (basic communications, ancillary to communications and non-communications) and a less burdensome, regulatory regime, employing non-structural safeguards, keyed to the degree of competition in each service area, to achieve a similar check on dominant carriers' (AT&T and the Bell Operating Companies) ventures into competitive markets.

Somehow, all of this complex regulatory maneuvering must accommodate the reality that foreign telecommunications and information processing markets do not fit into the FCC domestically based visions. Nevertheless, the Commission concluded:

> "It is important, therefore, that ISDNs be implemented in the U.S. in a fashion which is consistent with our Computer II decision and other competitive policies."(9)

The FCC will attempt to structure the evolution of ISDN into the service categories of the Computer Inquiries, with the nature and scope of regulation similarly keyed to those domestic policy initiatives:

> "Our Computer II rules and policies are established and should be properly accommodated in the ISDN planning efforts." (10)

THE COMPUTER INQUIRIES HAVE LIMITED APPLICABILITY FOR INTERNATIONAL SERVICES

Service segmentation fostered by the FCC's Computer Inquiries will not likely pass muster in international forums or with foreign administrations that will seek to incorporate any profitable "enhanced" or "ancillary to communications" feature within their ISDNs. The FCC can anticipate discrete domestic basic and enhanced ISDNs, but foreign countries are likely to invest in a singular ISDN without regard for where or how the basic information transport function ends and the enhanced information processing function begins.

The substantial investments needed to update or replace existing networks prompt foreign carriers to maintain their monopoly stronghold over any service that arguably fits within the rubric of PTT service. Because a single ISDN can serve as both a "basic" and "enhanced service" pipeline, any restriction on who can provide a particular subset of ISDN services or how the market will be structured addresses regulatory, marketplace and policy goals rather than technological imperatives.

A fundamental deviation in interests and philosophy over ISDNs may pit the United States against other nations. The PTT consolidation of any new service transportable over ISDN conflicts with U.S. policies favoring a plethora of carriers and services subject over to that degree of regulatory oversight necessary to protect the public interest. The juxtaposition of national interests may temper or force modifications to the international application of a U.S. philosophy supporting substantially unregulated marketplace competition.

The capacity of ISDN to handle many types of information processing applications may bring aspects of data processing under the realm of the PTT. With the attachment of equipment at both ends of the line and with application of protocols designed to accommodate diverse types of data transmission, the PTT in essence furnishes an intelligent information services transmission network. Expanding the "wingspan" of a government agency or franchisee conflicts with a U.S. policy favoring private enterprise and restricted government intrusion. The FCC has taken great efforts to free information processing from any regulation by concentrating on how the telecommunications building blocks are procured and tariffed, rather than who provides a particular service.

Given the U.S. goal to confer maximum sovereignty and flexibility to the telecommunications user, foreign PTT efforts to incorporate new data processing services conflicts with the U.S. deregulatory campaign. As a result:

> "in the U.S., competitive market forces could result in some deviation from ... [international ISDN] standards. If, in the U.S., customer premises equipment were to operate at standards which were technically incompatible with or inferior to CCITT adopted standards, it could result in traffic being restricted to domestic termination points, unless an additional layer of hardware and/or software could be added." (11)

Unless the U.S. succeeds in having international forums adopt a flexible approach whereby customers and not carriers alone can configure the ISDN, three outcomes injurious to U.S. users, service providers and equipment suppliers may result:

- o "enhanced" or "ancillary to communications" service providers, permitted by the U.S. to operate without regulation and FCC authorization, must acquire foreign operational privileges and may experience difficulty in convincing PTTs that they are as reliable and legitimate as regulated basic services common carriers, who will similarly operate over the ISDN;
- o U.S. manufactured equipment, designed to furnish enhancements to basic transmission capacity, may duplicate functions built into the ISDN thereby rendering the U.S. offerings superfluous or inadequate; and
- o any U.S. move to favor native customers, carriers or manufacturers in the public interest may fail to secure international acceptance and compatibility with international ISDN standards.

Even at the incipiency of ISDN, domestic-based regulatory dilemmas and marketplace philosophies may generate confusion, additional costs or barriers to entry. ISDN, as an evolutionary concept in telecommunications and information processing transport, should not become embroiled in semantic line drawing, particularly if specific regulatory adjustments to accommodate characteristics of the international marketplace are possible without contaminating the domestic market benefits accrued from the policies expressed in the Computer Inquiries.

RECENT EFFORTS TO ACCOMMODATE PRACTICAL AND EFFICIENCY CONCERNS BRING THE FCC CLOSER TO FOREIGN ISDN VIEWS

While not deliberately forsaking its quest for multiple ISDNs, accessible in both a transparent "basic," private line or packaged "enhanced service" format, the FCC has made accommodations, within its Second Computer Inquiry policy, that promote greater consolidation of functions within the network. While it has not bolstered its commitment to international community (12), the Commission has granted waivers to permit certain types of protocol conversions (13) and flexibility in network channel terminating equipment location (on the customer's premises or at telephone company switching offices)(14). These actions bring the Commission closer to the PTT view of a single, versatile ISDN and may promote symmetry in U.S.-CCITT service definitions. However, consolidating the array of domestic U.S. and international ISDN services may occur at the expense of consumer choice, particularly the opportunity to engineer private line ISDNs and to attach customer-tailored CPE.

PRESERVING ISDN TRANSPARENCY

PTT marketing strategies, CCITT definitions and recent FCC regulatory policy revisions that permit greater consolidation of intelligence within the network, promotes singular ISDNs with costly built-in futures not necessarily required by, or desirable to, all users. The FCC apparently is unwilling to "sacrific[e] material efficiencies to achieve competitive party" (15) by derpriving dominant carriers from attaching ISDN providing equipment at the switching office, and thereby accruing service and marketplace advantages merely by reserving solely for itself the right of equipment co-location. However, the Commission purports to remain vigilant against the imposition of "unnecessary costs ... on customer premises equipment to the extent that it includes functions ... which are not used ... [because the network itself already provides the functions pursuant to CCITT] ISDN recommendations to support a full-range of ISDN services." (16)

How ISDNs will apportion functions to the network and equipment attached by the user to the ISDN, in large part, will determine whether the future delivers the diverse, multiple ISDN environment advocated by the FCC or the single ISDN which must be "all things to all users" as most PTTs envision. While the FCC may be able to employ service definitions for purposes of variable domestic regulation and structuring U.S. ISDN suppliers and service providers, it may not be able to dissuade PTTs from consolidation of services into a singular ISDN. This will moot any international application of FCC orchestrated differentiation between enhanced and basic ISDNs.

THE THREAT TO CONTINUE AVAILABILITY OF PRIVATE LINE OFFERINGS

ISDN, by its integrated nature, constitutes a public switched as opposed to private, dedicated service. Given the expense incurred in development of ISDNs, PTTs have the incentive to restrict the availability of user specific, dedicated line options that have been priced on a flat rate. Such a concentration of attention and resources may well frustrate or defeat specific consumer needs best met when users can engineer their own private ISDN with the lowest number of physical interfaces between terminals and transmission lines. A public ISDN is apt to represent a functional compromise favoring ubiquitousness over specific customer-tailored needs. Performance, flexibility, security and economic characteristics of an ISDN may not match the levels even currently attainable through large private user networks, e.g., secure, encrypted military data links, high volume, speedy banking networks and global airline reservation systems.

Several large volume or specialized network users vigorously argued that the Commission and other U.S. government agencies should push for the continued availability of private line service options. Commentators objected even to an ISDN system that can guarantee particular customers a specific set of circuits available on a 24-hour demand, but not dedicated, basis. Such "virtual circuit" systems are considered inadequate in part due to performance factors (delays in access for data transmission and need to apply standardized protocols), but also because a switched ISDN system will likely be configured to meter and charge for service on the basis of usage. Forced migration to public ISDNs will engender severe rate hikes for large volume private line users, even as flexibility is reduced.

The commission was persuaded that switched public ISDNs may constrain the manner in which certain users have enjoyed line leasing on a bulk, usage intensive basis. Notwithstanding the claims of U.S. carriers that demand basis metered circuits may adequately serve subscriber needs, the Commission sided with users. The Commission held that its "Computer II unbundling principle would best be served by the continued availability of dedicated private line services notwithstanding the emergence of packet-switched and circuit-switched ISDN alternatives ...." (17)

CONCLUSION

The FCC's easy access, multiple vendor ISDN vision may not achieve international approval. Unwavering fealty to competitive marketplace resource allocation ignores the reality that most telecommunications networks are government owned and fettered with a plethora of inefficient, but ostensibly pro-social obligations. While acknowledging that "it is not the function of this Commission to plan or to design carriers' and others' ISDNs," (18) the FCC has established a provocative agenda of issues because of unwavering pro-competitive philosophical convictions, and more practically, because "technical and other judgments involved in ISDN planning can and do raise policy issues ...." (19)

As ISDN evolves, the FCC can be expected to advocate:

- ISDN planning from a user perspective;
- a multi-vendor ISDN marketplace;
- maximum consumer flexibility in accessing ISDNs, including an internationally adopted numbering/addressing plan for easy dial up;
- the ability of end-users to attach any type of CPE that is "privately beneficial without being publicly detrimental";
- user rights to attach customer-tailored CPE to secure services that the network may also provide on an optional basis;
- compatibility of Computer Inquiry service definitions with those of international forums so that the United States can achieve domestic regulatory goals without fettering U.S. or foreign service providers;
- international interconnection and operational policies that permit multiple, diverse and competitive carrier services; and
- retention of dedicated private line service leasing in the face of mounting foreign pressure to favor public, switched "virtual circuits," - non-dedicated, but readily available facilities.

The Commission at some point will review the ISDN applications of new and existing carriers. It must resolve such matters as carrier-to-carrier and user-to-carrier interconnections and questions of how domestic policies jibe with international standards. Without becoming an appellate body or arbitrator of non-policy or design issues, the Commission will likely pursue its "international interest in the ISDN planning process," (20) with an eye toward international forum accommodation of U.S. policies.

Given that most nations will favor a single ISDN owner/operator, U.S. policy-making bodies will likely experience resistence to advocacy for a multiplicity of carriers and networks. Because future generations of telecommunications and information processing networks depend on current planning efforts, the FCC must acknowledge fundamental economic and industrial structure differences with foreign nations and devise methods for making prudent accommodations.

FOOTNOTES

(1) The FCC defines ISDN as "a network which is designed and constructed to provide a wide range of telecommunications and information services and to transport electrical signals in digital, rather than analog form." Integrated Services Digital Networks (ISDN), Notice of Inquiry, 94 F.C.C.2d 1289 (19830 [hereinafter cited as ISDN Notice].

(2) Id. at 1290.

(3) Integrated Services Digital Networks (ISDN), First Report, 98 F.C.C.2d 249, 289 (1984) [hereinafter cited as ISDN Report].

(4) See Frieden, International Telecommunications and the Federal Communications Commission, 21 COL.J. TRANSNAT'L L. 423 (1983).

(5) ISDN Notice, 94 F.C.C.2d at 1305.

(6) Id. at 1303-1304.

(7) The FCC acknowledges that the "recommendations [which the] CCITT formulates will directly affect U.S. ISDNs, service providers, equipment manufacturers and users. In order to interface with the ISDNs of other nations, a nation's ISDN(s) must be compatible with them at the point of interface. ISDNs will have to be designed to transmit data through interfaces with other nations' ISDNs in formats which are compatible with, or convertible to, internationally agreed upon specifications, to permit interworking." Id. at 1302-1303.

(8) The Second Computer Inquiry defines basic services as "the common carrier offering of transmission capacity for the movement of information." Amendment of Sec. 63.702 of the Commission's Rules and Regulations (Second Computer Inquiry), Final Decision, 77 F.C.C.2d 384 (1980), [hereinafter cited as Second Computer Inquiry-Final Decision] on reconsideration, 84 F.C.C.2nd 50 (1980), on further reconsideration, 88 F.C.C.2d 512 (1981), aff'd sub nom.

Computer and Communications Industry Ass'n v. FCC, 693 F.2d 198 (D.C. Cir. 1982), cert. denied, 461 U.S. 938 (1982). A carrier "essentially offers a pure transmission capability over a communications path that is virtually transparent in terms of its interaction with customer supplied information." Second Computer Inquiry-Final Decision, 77 F.C.C.2d at 420. Hence, communications common carriage of basic transmission service is merely the offering of a communications path that can be used to send voice, data or video signals depending on the parameters of fidelity, distortion or conditioning in the technical preparation of the line. See id. at 419.

Enhanced services are offerings over a telecommunications network that add computer processing applications and "act on the content, code, protocol, and other aspects of the subscriber's information." Id. at 420. This category covers services that use computerization to offer "additional, different, or restructured information ... provided [to] the subscriber through various processing applications performed on the transmitted information," or that use computers to add stored information. Id. at 420-21.

The Third Computer Inquiry Notice of Proposed Rulemaking treats "basic communications" in the same manner as in the Second Computer Inquiry, viz., the "transport of information and electrical signals from one subscriber to another unchanged." Amendment of Sec. 64.702 of the Commission's Rules and Regulations, (Third Computer Inquiry), CC Docket No. 85-229, FCC 85-397 at 19, Para. 40(a) (1985), [hereinafter cited as Third Computer Inquiry-Proposal]. "Ancillary to communications offerings "are not directly regulated, ... [e.g.,] the supply of customer premises equipment and the offering of enhanced services as presently defined." Id. at 19, Para. 40(b). "Non-communications" are "offerings that do not involve communications, but which if made by an entity otherwise regulated under the [Communications] Act might have some effect on that entity's ability to discharge statuatory obligations governing its regulated offerings." Id. at 20, Para. 40(c). See infra notes 13, 14.

(9) ISDN Notice, 94 F.C.C.2d at 1302.

(10) ISDN Report, 98 F.C.C.2d at 267.

(11) ISDN Notice, 94 F.C.C.2d at 1303.

(12) "[I]t is not our intention to hinder the process of international activities or unilaterally impose standards in lieu of CCITT's efforts." Id. at 1307.

(13) A protocol is a convention which allows parties to execute transactions between them by complying with an agreed upon set of rules, the protocol, which govern the transaction and make it orderly. The FCC explains that " '[p]rotocals' govern the methods used for packaging the transmitted data in quanta, the rules for controlling the flow of information, and the format of headers and trailers surrounding the transmitted information and of separate control messages." Second Computer

Inquiry-Final Decision, 77 F.C.C.2d at 420, at n.33. Where efficiency, technological necessity or user convenience warrants, the FCC has reinterpreted its service definitions or granted waivers to its separate subsidiary requirements to permit protocol conversions. See Communications Protocols under Sec. 64.702 of the Commission's Rules, 95 F.C.C.2d 584 (1983), Petitions for Waiver of Sec. 64.702 of the Commission's Rules and Regulations to Provide Certain Types of Protocol Conversion Within Their Basic Telephone Networks, FCC 84-561 (rel. Nov. 28, 1984) (permitting X.75-X.25 conversions on an unseparated basis); Petitions for Waiver of Sec. 64.702 of the Commission's Rules (Computer II), FCC 85-101 (rel. March 26, 1985) (permitting conversions from asynchronous to X-2.5 protocols within Bell Operating Co. switching offices).

(14) The Commission also permits local exchange telephone companies to attach network channel terminating equipment to central office switches, even though the equipment generally is considered CPE. American Information Technologies, Inc., Petitions for Waiver of Sec. 64.702 of the Commission's Rules and Regulations to Enable Certain Bell Operating Cos. to Offer Digital NCTE Without Structuring Separation, Mimeo No. 6893 (rel. Sep. 11, 1985).

(15) Third Computer Inquiry-Proposal at 49, Para. 116.

(16) ISDN Report, 98 F.C.C.2d at 262.

(17) Id. at 279.

(18) Id. at 285.

(19) Id.

(20) Id. at 289.

New Home-Use Media and Japan's General Public

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1. Abstract

Videotex, Two-Way Cable Television, Direct Broadcasting Satellite and other new electronic media have been appearing in Japan as in the other advanced countries. From the viewpoint of home-use, however, practically all these media are still at an experimental stage and their future developments are, in general, yet to be assured. This paper will (1) introduce the current situation of some new media under development, (2) discuss their merits relative to the existing daily-life means, both in this country, and (3) point out some conditions that are considered to be desirable for the future prosperity of the electronic media for home-use.

2. NEW HOME-USE MEDIA YET TO TAKE OFF

The development of new electronic communication media, which are usually called just "new media" has been a topic of conversation here since a few years ago. The concept of "new media," however, is too broad to discuss, and in this paper, the author will deal only with the newly coming services that have been developed for the daily use of the general public through a new type terminal or an adapter to existing terminal installed in the home. Most of thus defined new media, however, are at an early stage of development. Typical such examples will be explained below.

A Japanese version of videotex, CAPTAIN, has been in commercial operation since November 1984. Its terminals number about 8,000 as of the end of September, 1985, showing a moderate growth of this service as a whole. Of these, however, home-use terminals total only about 940, and this low figure indicates clearly that this service is not welcomed for home-use.

A small-scale two-way cable television system, HI-OBIS, has been under experiment at Ikoma near Osaka for about ten years. Also, some hotels have already been equipped with a cable television system with program-requesting channels. These cases, however, are exceptional, and most cable television suppliers do not plan to introduce two-way facilities. Further, cable television subscribers in Japan number 4 million. This figure corresponds to about 12% of TV equipped households and is lower than those in other advanced countries.

BS-2, a direct broadcasting satellite has been operated experimentally by NHK, Japan Broadcasting Corporation, since May 1984. This experiment is a preliminary one to be followed by BS-3 that will be launched in 1990, and most of the programs through BS-2, at the moment, are the same as those through regular surface waves. Partly because of this, BS has not been popularized yet among the general public here.

A prototype of Information Network System (INS) has been operated by Nippon Telegraph and Telephone Corporation (NTT) for the experimental use of some 550 subscriber in Mitaka Area, a western suburb of Tokyo since September 1984. The purpose of this experiment seems primarily in stimulating business uses in the near future. The terminals of the INS Model, however, include those for videotex, digital facsimile, Video Response System (VRS), telewriting and other services that can be used for home-communications, too. Because both the service area and the number of terminals are very limited, however, this pilot service has not been highly evaluated by the general public yet.

As shown in the above examples, the regularization of service will only be a future issue for practically all the new home-use media in this country. Their future development depends highly upon if the suppliers can find and commercialize a service that meets well the user's requirements.

3. PEOPLE'S ATTITUDE TOWARD COMMUNICATION MEDIA

"White Paper on Communications" auunally compiled by the Ministry of Posts and Telecommunications says that the effective usage rate of supplied information has been falling year by year contrary to the marked increase in the amount of supply. This fact can also be testified by examining the results of "Survey on People's Daily Life Activities" that is conducted by NHK every five years. In other words, as shown in Figure 1, the people's time spent for attaining information has increased, on average, only at a modest rate, approximately 1% per year, in the past two dacades.

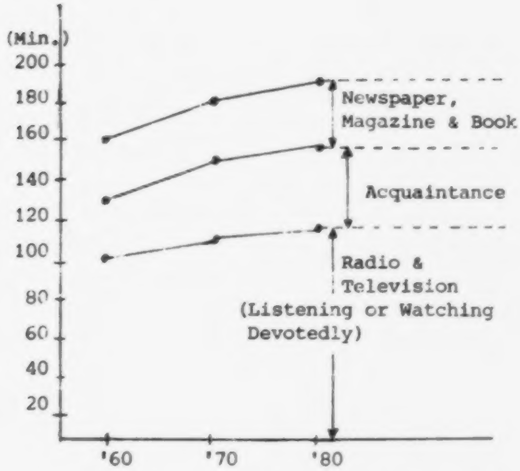


Figure 1. PEOPLE'S DAILY-LIFE TIME

Another statistics in the White Paper shows that the proportion of information-related household expenditures to total has remained at about 2% without a remarkable change in the past ten years.

These chronological figures seem to suggest that at least in Japan, the people's time and money spent for information will continue to make a modest increase and that a rapid expansion of the information market cannot be expected as a whole from the home-use media viewpoint. In this regard, it should be remembered as a good example that in late 1960s, the rapid popularization of television reduced drastically the number of movie-theater visiters in this country.

Unlike such civil-minimum services as telegraphy and telephony, practically all new services under development do not seem necessary but just desirable for the people's daily life. For the new services to develop, therefore, they must give a remarkable cost-benefit that cannot be done by the existing communication media and other daily-life means, which may differ by the country concerned. This viewpoint will be explained by taking some Japanese examples.

4. NEW MEDIA COMPETING WITH EXISTING DAILY-LIFE MEANS

(1) Home-Shopping

Japan's population density in habitable land-space and her retail-store density are both very high, compared with, for example, those of the United States as shown in Table 1. As a result, most people in Japan have easy access on foot to shopping facilities. Further, the around-the-clock operation of "Convenience Stores" has been common in city areas. No other new media is thus considered highly necessary for the people to purchase daily necessities.

Meanwile, some people buy clothes, furnitures, electric appliances and other goods through the conventional communication media. This type of sales amounts to about 3.3% to total retail sales and is growing at an annual rate of 15 to 20%. The media presently used thereof are the printed and broadcast advertisements for getting information, and the mail and telephone services for ordering.

(2) Home-Banking

Although no home-terminal thereof is used, a cashless method of money transfer has been used widely in Japan since a quarter of century ago. By making a contract with the banks, people use automatic transfer-account services for receiving salaries from their employers and for paying the bills of such public utility services as telephone, power, water, and TV subscription charges. Money transfer information is sent from the bank to its customers through mail or telephony, which is sometimes combined with computer-compiled announcements. A part of so-called home-banking functions have thus already been fulfilled here.

Under these circumstances, it seems rather difficult to expect that some new type home-terminals are widely used for banking as well as shopping purposes in the near future unless the use of them gives some remarkable cost-benefit to the user.

(3) Cable Television

As already stated, cable television in Japan has not been so popularized as in the other countries. There are two reasons for this. First, the service of NHK (Japan Broadcasting Corporation) has already covered over 98% of households in

Table 1. JAPAN VS. UNITED STATES

	Japan	U.S.	Ratio
Population per km^2 of habitable lnad space	1,481	51	29.0
No. of retail stores per 100 inhabitants	1.38	0.77	1.8
No. of visits to movie theaters per capita	1.4	4.7	0.3
Daily newspaper circulation per 1,000 population	569	284	2.0

this country. Second, VHF frequency resource is available for such domestic use that five to seven channels are in operation in most areas.

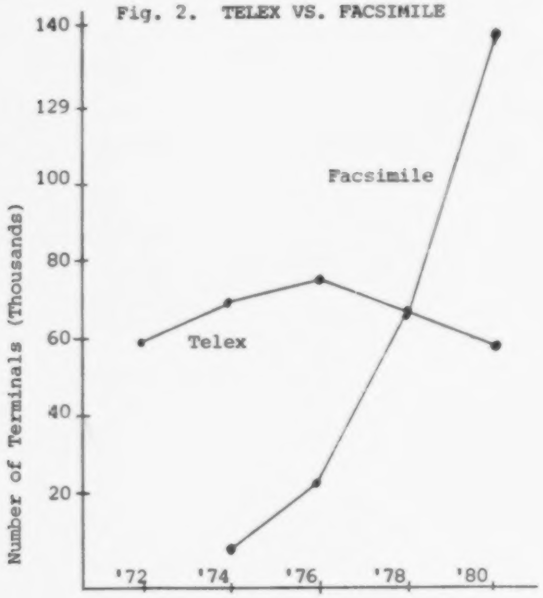
Further, the number of movie-theater visitors per inhabitant is about one third as many as that in the United States. Some 30% of households here already keep a VTR. These two facts may be other causes to limit cable television development in Japan. Cable television suppliers should therefore find out some remarkable merits to override these conditions.

(4) Input Methods of the New Media

Most of the new media are to be made use of by manipulating a keyboard. The majority of Japanese people, however, has not been accustomed to and has tended to keep away from the use of typewriter and other key equipment, clearly because of difficulties in dealing with Japanese characters. This was testified by the fact that in the middle of 1970s, the number of telex subscribers started to decrease with the sharp increase of facsimile as shown in Figure 2. At the end of March 1985, telex and facsimile terminals in operation numbered 34 thousands and 730 thousands respectively.

The allergy to the keyboard is gradually changing. The result of a survey by IFTECH in 1984 shows that 46% of office workers aged 20s think keyboard more effective than the other input methods, while only 17% of office workers aged 30s or older do so. It will, however, take time for this tendency to cover Japan's public as a whole. The author therefore think that the development of an effective voice or hand-writing input method other than keyboard would still be highly desirable for popularizing any new medium in Japan, at least for the coming decade or so.

Fig. 2. TELEX VS. FACSIMILE



5. SUGGESTIONS FOR NEW SERVICE DEVELOPMENT

The development of new home-use media in Japan, after passing the first phase of technical experiments to date, should move to the next phase of actual service, for which users requirements will have to be studied deeply in advance. From this viewpoint, the author would like to make a few suggestions that may contribute to the future prosperity of new media.

Table 2 shows a part of the results of a survey by IFTECH in 1982. In the survey the preference of 21 items of future telecommunication services were asked to about 800 people in Tokyo and Osaka. Although the survey was conducted three years ago, its results are considered still meaningful, because such survey as this has hardly been heard of thereafter in this country.

Table 2. PREFERENCE OF FUTURE HOME-USE TELECOMMUNICATION SERVICES

Order	Service	Vote (%)
1	Voice message	13.8
1	Security	13.8
3	Mobile telephone	10.1
4	Group communication	9.3
5	Daily-use information	6.7
6	Video-program request	6.4
7	Video-phone	5.9
8	Telecontrol of home appliances	4.9
9	Telephone with telewriting	4.0
10	Dictation	3.8
11	Home-banking	3.7
12	Multi-destination facsimile	2.5
⋮	⋮	⋮
17	Home-shopping	1.2
⋮	⋮	⋮
20	High-definition TV	0.7
Total		100.0

Features common to the services holding 1st to 4th position in the Table are:

(i) To meet requirements of a real-time character
(ii) To compete with practically no other alternative means

Conversely, such services as home-shopping and home-banking lack the above features and rank rather lower in the Table. These two features should be given the highest priority of consideration in developing new telecommunication services. In fact, the security service using leased lines has already been commercialized by a number of firms, of which the largest one has over one hundred thousand customers.

Another survey was conducted by IFTECH in 1984, relating closely to the "Daily-Use Information Service" that ranks fifth in Table 2. In this survey, 370 citizens were asked the existing media that are most frequently used by them on twenty-eight kinds of presupposed occasions. As shown in Table 3, the results say that for some purposes, person-to-person communication is still an important means, and cannot have been replaced by printed and electronic media. The person-to-person communication was given the highest priority by over forty persent of respondents when they look for local information of hospitals, house-repairers, beauty-parlors and restaurants that would meet their occasional requirements.

Table 3. CHOICE OF INFORMATION SOURCES IN TWENTY-EIGHT OCCASIONS

Information source (A)	No. of occasions where 1st or 2nd choice was (A)
Print media	20
Broadcast media	9
Telecommunication media	3
Person-to-person communication	20
Field observation	4

Some of the information sought here relates to an object that has alternatives and is chosen subjectively. Requirements for this kind of information may be satisfied, not by videotex or other purely mechanical service but by, for example, an operator answering telephone service aided by a database.

As suggested in the above case, telephone service still has a number of future capabilities. Especially in Japan, the existing telephone service seem less varied than in other countries and will have to be enhanced further. In this regard, it is good news for the telephone subscribers that "Triophone," a similar service to "Group Communication" in Table 2 has been made practical recently and that a service equivalent to "800" in the U.S., will soon be inaugurated, both by NTT.

As discussed eartier in this paper, the Japanese people are not accustomed to keyboard operation and they will react negatively to any newly developed medium if it necessitates a complicated input operation through a keyboard. From this viewpoint also, telephone set will play an important role here as a simple home-terminal of future new media.

The services ranking 6th and 7th in Table 2 relate to video-communication. No mention was made of service charges in the questionaire of the survey however. If these video services were to be charged several ten times as high as telephone, they would surely have ranked at far lower positions. The author thinks that any video communication service for home-use will be welcomed only if their charges are at a rate within ten times of telephone charges, and that technical development will have to be aimed at making this practical. The reason is that the Japanese people may think this figure "ten times" fairly resonable, because such figures as the receiver prices and advertisement rates of television at present are nearly ten times as high as those of radio.

6. CONSIDERATION ON HOME-USE TERMINAL

The development of a new service depends highly upon the price of its terminal, in particular, when the service requires the installation of a new terminal in the home. This is clearly shown in the results of a survey by IFTECH, in 1984 regarding to the demands for CAPTAIN. (See Table 4)

Table 4. PURCHASE OR USE OF CAPTAIN TERMINAL

Reply	
Intend to purchase	
-Irrespective of the price	1.2
-If the price is; ¥200,000	0.4
¥100,000	3.8
¥50,000	14.1
¥10,000	17.6
Intend to use at a public station	34.7
No intention of purchase or use	26.6
No answer	2.1
Total	100.0

(N: 1122)

There will be a few ways to stimulate the use of a new service which requires a new terminal. First, as suggested by the figures in Table 4, the installation of a public-use terminal like a coin telephone may be effective. Second, as exemplified by Minitel in France, it will also be effective to provide the user with a charge-free terminal which can be used for universal purposes, under the financial assistance of the government. This second way, however, may be difficult to expect in Japan where telecommunication businesses are privatized.

The third way that may be very effective for the future is to promote the use of a personal computers as the terminal of new services. As stated earlier in this paper, the Japanese people feel, in general, difficulties in operating keyboard. Nevertheless, the younger people have come to be accustomed to it recently, and personal computer communications are also taking off among them. In this sense, it was very timely that the Ministry of Posts and Telecommunications defined a technical standard for the personal computer communication in spring 1985.

7. CONCLUSION

Similarly to home electric appliances, the new home-use electronic media will be used under the people's free choice. The newly coming media have thus to compete with a variety of existing telecommunications, broadcast and printed media in the cost-effectiveness given to the people. The suppliers of the new media should therefore endeavour every effort to find out genuine needs of the people by examining carefully local environmental conditions concerned.

What is substantially needed by the people is a new service itself and not a new terminal. To reduce the user's expenses to a minimum, it will be favourable that the new service is so arranged as to be used at a public station or through a personal computer. In parallel with this, it is highly desirable, from the viewpoint of the general public, to develop telephone-based new services, an example being a telephone answering service aided by a database, which was mentioned in this paper. Because telephone will continue to be the most popular terminal for the general public.

A PC-based Videotex Terminal
with Chinese Language Capability

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1. Abstract

The CVS (Chinese Videotex System) is a new public service which will be available for two-year field trial, starting in August this year. An information consumer can retrieve both Chinese and English information, provided by information providers, stored in the database of videotex center or some other external computers. The information is coded in NAPLPS (North American Presentation Level Protocol Syntax) and ISO compatible Chinese coding scheme called Chinese Code for Data Communications. Service functions include : Information Retrieval, Close User Group, Transactions, Message Exchange, Gateway to External Database, and Telesoftware. This paper describes the details of important design aspects of a PC-based videotex terminal which is used in this service.

2. OVERVIEW OF CVS

2.1 INTRODUCTION

The components involved in CVS (Chinese Videotex System), are videotex center, telecommunications network, videotex terminals of information consumers and information providers, external databases and gateways as shown in Figure 1. There are three types of terminals for information consumers: TV set plus a decoder as the videotex terminal, the dedicated videotex terminal, and the PC-based videotex terminal. The gateway facilities are used as bridges of external databases and videotex center by using of packet switched data network, called PACNET. During the field trial, the videotex center is located in Taipei. Users can access videotex center through either PSTN (public switched telephone network) or PACNET. The transmission scheme used is asynchronous 1200/1200 bps 2-wire full-duplex (i.e. CCITT V22 or Bell 212A) dial-up approach. To ensure the system reliability, videotex center uses two VAX/780 configurated in cluster environment as shown in Figure 2. The database capacity in the initial phase is over 200,000 frames.

2.2 SERVICE FACILITIES

The service functions to be provided are :

- INFORMATION RETRIEVAL
  Information consumers can obtain information by means of a dialogue with the data base.
- CLOSED USER GROUP
  A group of users who are permitted to access parts of a data base or other videotex service facilities that are not available to other users.
- TRANSACTION
  Information consumers can create and/or modify information stored in a data base. The service facility includes, but is not limited to, transactions leading to or influencing a comercial relationship between information consumers and information providers.
- MESSAGE EXCHANGE
  Information consumers can communicate with each other by storing messages in a commonly accessible data base.
- GATEWAY
  A gateway provides access of data base(s) of other computer(s).
- TELESOFTWARE
  Information consumers can employ processing and storage capacity by downloading a program or other data into suitable videotex terminal equipment.

2.3 PRESENTATION LEVEL PROTOCOL

The Presentation layer is the sixth layer in the Open Systems Interconnection (OSI) model of the International Standard Organization (ISO). The Presentation Level Protocol Syntax (PLPS) defines the presentation of textual, graphical and other information. In CVS, we adopt the

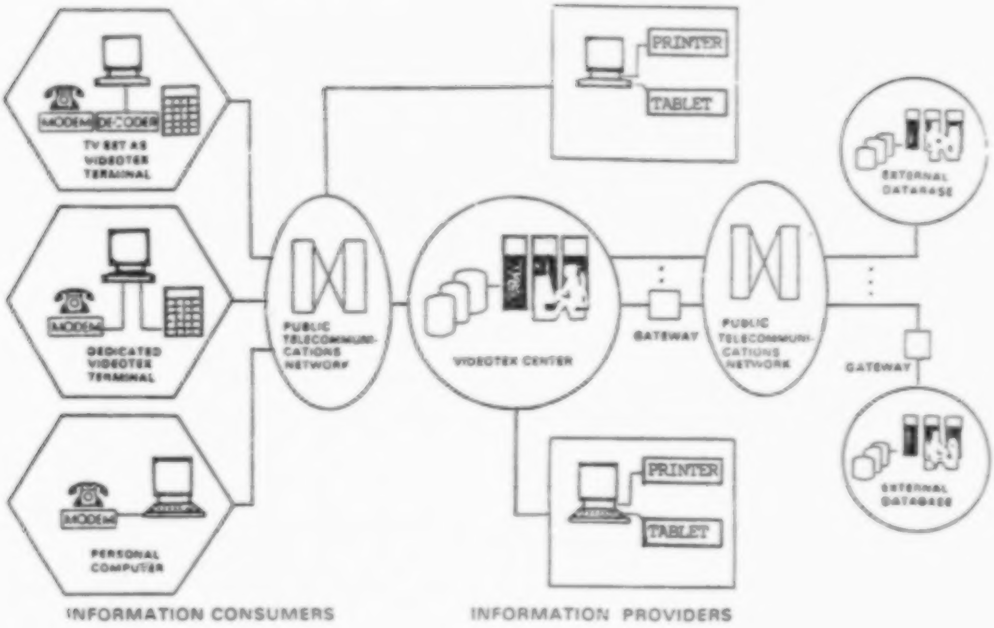
MODEM
DECODER
TV SET AS VIDEOTEX TERMINAL
MODEM
DEDICATED VIDEOTEX TERMINAL
MODEM
PERSONAL COMPUTER
PUBLIC TELECOMMUNICATIONS NETWORK
VIDEOTEX CENTER
GATEWAY
PUBLIC TELECOMMUNICATIONS NETWORK
GATEWAY
PRINTER
TABLET
PRINTER
TABLET
EXTERNAL DATABASE
EXTERNAL DATABASE
INFORMATION CONSUMERS
INFORMATION PROVIDERS

Figure 1 BLOCK DIAGRAM OF THE CHINESE VIDEOTEX SYSTEM (CVS)

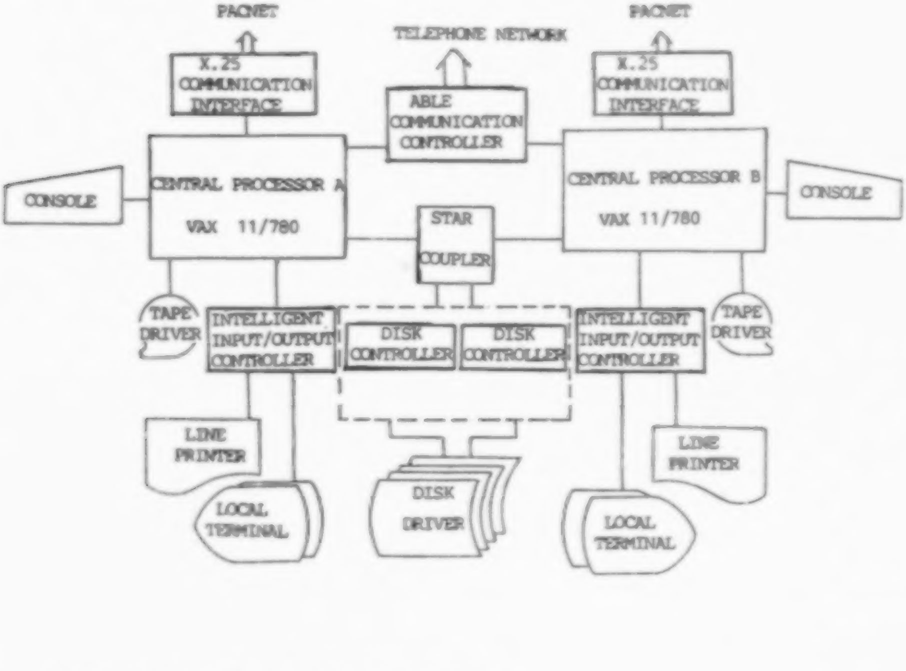
PACNET
TELEPHONE NETWORK
PACNET
X.25 COMMUNICATION INTERFACE
ABLE COMMUNICATION CONTROLLER
X.25 COMMUNICATION INTERFACE
CONSOLE
CENTRAL PROCESSOR A
VAX 11/780
STAR COUPLER
CENTRAL PROCESSOR B
VAX 11/780
CONSOLE
TAPE DRIVER
INTELLIGENT INPUT/OUTPUT CONTROLLER
DISK CONTROLLER
DISK CONTROLLER
INTELLIGENT INPUT/OUTPUT CONTROLLER
TAPE DRIVER
LINE PRINTER
LOCAL TERMINAL
DISK DRIVER
LOCAL TERMINAL
LINE PRINTER

Figure 2 VIDEOTEX CENTER EQUIPMENTS

North American Presentation Level Protocol Systax (NAPLPS) and the Chinese Code for Data Communications (CCDC) as our presentation layer protocols. The CCDC was published in Augest 1983 by the Directorate General of Telecommuniucations (DGT). Its coding structure complies to ISO 2022-1982 [1] [4]. The detail will be discussed in Section 3.

2.4 PC-BASED TERMINAL

Since the videotex terminal should be popular and powerful, the use of PC-based terminal is attractive. In this country, the personal computer has already become quite widespread, cost effective, and functions growing. The videotex capability can make personal computers value-added, and the PC users will easily accept the videotex service. We have developped a videotex card and a software program to make the IBM_PC or compatible PC as a videotex terminal of CVS. The videotex card with the program can decode the NAPLPS and CCDC information.

3. THE CODING SCHEME OF CVS

There are three major videotex graphical coding approaches at present: geometric, mosaic and photographic coding methods. They are used in the following three major videotex standards : the North American Presentation Level Protocol Syntax (NAPLPS), the Conference of European Posts and Telecommunications (CEPT), and Pattern Telephone Access Information Network (CAPTAIN). Due to the difference in the major graphical representation methods, they are not compatible so far. The information interchange among them is not permitted.

We adopt NAPLPS to be our major graphical representation standards, with the Picture Description Instruction (PDI) set of geometric coding. The reasons are :

- Although NAPLPS emphasizes on geometric coding with the PDI set, it also has mosaic and photographic presentation capabilities. We can implement photographic coding with the INCREMENTAL POINT command of PDI set. The mosaic coding is also a standard coding method in NAPLPS.
- With a sufficiently large bit plane memory, the CCDC and three coding methods can be incorporated.
- There are good picture quality and reasonable bandwith in geometric coding. It is necessary for transmission of photographic coded information by using wider bandwidth, which is much easier to be realized after ISDN is completed in this country.
- Geometric coded information, which is compatible with computer graphics, is independent of physical resolution, and thus better device independance.
- The disadvantage of larger memories and more complex terminal logic will be reduced because of cheaper hardware.

In the following paragraphs, we will give a brief description of the major features of NAPLPS, CCDC, and the related coding scheme.

3.1 NAPLPS

According to the recommendation of ISO 2022 code extension technique (3), the code extension of NAPLPS was established in detail. There are two control character sets and six graphic character sets in character repertoire, but no multiple-bytes graphic character set.

The functions of the two control character set, C0 set and C1 set, are textual attribute control, code extension control, lower layer comunication protocol or device control, Macro/DRCS/Texture mask definition, unprotected field data downloading, and others.

The graphic character sets are the Primary character set, the Supplementary character set, the Picture Description Instruction (PDI) set, the Mosaic set, the Macro set and the Dynamically Redefinable Character Set (DRCS). The Primary character set, Supplementary character set and DRCS are displayable textual characters. The Mosaic set is a six-cells block graphic representation with textual attribute as same as textual characters. The Macro is a redefinable string of NAPLPS codes as a execution unit.

The PDI set contains geometric graphic primitives with specified opcode and associated operands. The primitives are point, line, arc/circle, rectangle, polygon, incremental point (raster-scan manner within one field) and incremental line/polygon (short line segment vector). On the other hand, the PDI also contains geometric attribute controls, color look-up table (colormap) control, and TEXT command of textural attribute.

3.2 CCDC

The Chinese Code for Data Communications (CCDC) is the basis to encode Chinese characters. There are three formats in this coding scheme: telecommunications code, transmission code, and storage code.

The Chinese characters are divided into two character planes - CCP1 (Chinese character plane 1) and CCP2.

Under the telecommunications code format, each position in CCP is represented by four decimal digits ranging from 0000 to 8835. CCP1 contains 7902 Chinese telegraph codes, 41 Chinese National Phonetic symbols, 94 ASCII alphanumeric symbols, and 6 special symbols. CCP2 contains 8489 additional Chinese characters. The remaining positions in each CCP can be used as user-defined characters, symbols, or phrases for his own purpose.

The transmission code of CCDC is based on ISO 2022. A multiple byte character set (or graphic repertory) with two 7-bit bytes are used for the Chinese characters. The first byte represents the higher part called B1, and the second represents the lower part called B0. The conversion between telecommunications code N and B1 B0 is defined by the following formula:

- Convert N to B1,B0
  B1 = INTEGER(N/94)+33
  B0 = INTEGER(N MOD 94)+ 33
  where
  B1 and B0 are in 7-bit binary format.
  N is a 4-digit decimal integer.
  INTEGER is a function to get the integer part of operand.
  MOD is a function to get the integer residue of operand.
- Convert B1,B0 to N
  N = (B1-33)*94+B0-33

3.3 CODE EXTENSION

The code extension illustration of 8-bit environment in CVS is shown in Figure 3. The invocation and designation sequences are based on ISO 2022-1982 , NAPLPS-1983, and CCDC. They are :

- Invocation sequences of G-set

SI : 0/15 ;lock G0 to GL
SO : 0/14 ;lock G1 to GL
LS2 : ESC 6/14 ;lock G2 to GL
SS2 : 1/9 ;single shift G2 to GL
LS3 : ESC 6/15 ;lock G3 to GL
SS3 : 1/13 ;single shift G3 to GL
LS1R: ESC 6/11 or ESC 7/14 ;lock G1 to GR
LS2R: ESC 6/12 or ESC 7/13 ;lock G2 to GR
LS3R: ESC 6/13 or ESC 7/12 ;lock G3 to GR

- Intermediate character of designation sequences of G sets in NAPLPS

94 code set	96 code set
G0 : 2/8	
G1 : 2/9	G1 : 2/9 or 2/13
G2 : 2/10	G2 : 2/10 or 2/14
G3 : 2/11	G3 : 2/11 or 2/15

- Intermediate character of designation sequences of multiple-bytes in CCDC

G0 : 2/4
G1 : 2/4 2/9 or 2/4 2/13
G2 : 2/4 2/10 or 2/4 2/14
G3 : 2/4 2/11 or 2/4 2/15

- Final character of designation sequences of G-set repertory

Primary character set : 4/2
Supplementary character set : 7/12
PDI set : 5/7
MOSAIC set : 7/13
MACRO set : 7/10
DRCS set : 7/11
CCDC CCP1 set : 3/0
CCDC CCP2 set : 3/1

The designation sequences of the CCDC is a multiple byte designation seguences (ESC, 2/4, I, F). By the recommendation from ISO 2022, the intermediate character (I) is null for G0 set, 2/13 for G1 set, 2/14 for G2 set, and 2/15 for G3 set. The final character (F) is used for Chinese characters is : 3/0 is for CCP1; 3/1 is for CCP2. We assign the Primary character set, which is compatible with ASCII, as the default of G0_set , the PDI set as the default of G1 set, and the Mosaic set as the default of G3_set. We assign the CCP1 as the default of G2 set because the Supplementary set is seldom used in this country. Note that CCP2 is not assigned as default set.

4. IMPLEMENTATION

4.1 FEATURES

The features of PC-based videotex terminal include:

- It can decode most of the service reference model (SRM) in NAPLPS standard.
- It can decode CCP1 and CCP2 in CCDC.
- It supports AT&T Session Layer Protocol.
- It supports screen hardcopy facility.
- The turn-key frame may changed easily.
- It permits online-editing by the unprotected field editor.
- It permits local file reading into unprotected field. . Resolution is on 256 pixels horizontal by 200 pixels vertical without implementation of the border area.

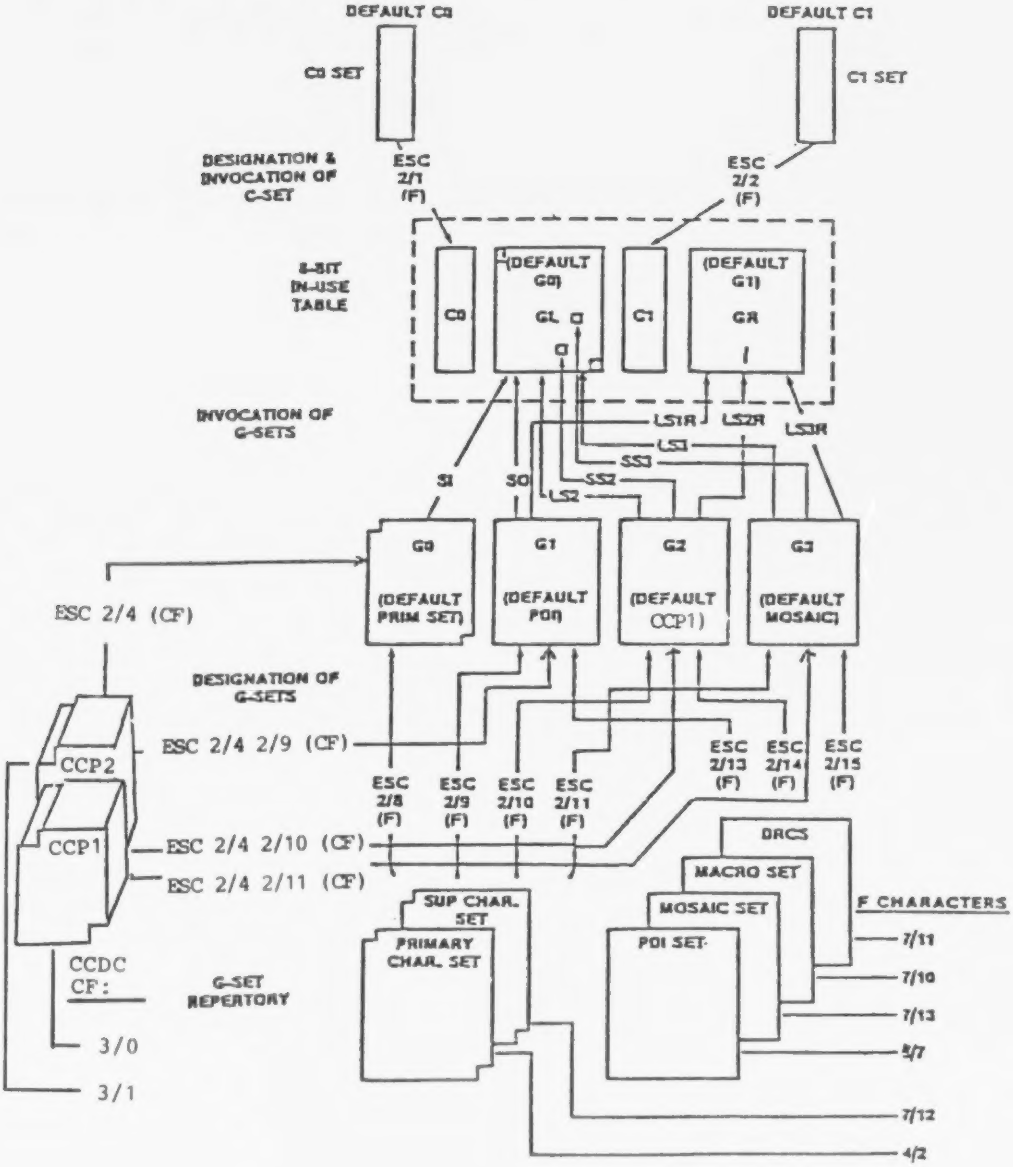
DEFAULT C0
C0 SET
DEFAULT C1
C1 SET
DESIGNATION & INVOCATION OF C-SET
ESC 2/1 (F)
ESC 2/2 (F)
8-BIT IN-USE TABLE
C0
(DEFAULT G0)
GL
C1
(DEFAULT G1)
GR
INVOCATION OF G-SETS
LS1R
LS2R
LS3R
LS1
SS3
SS2
LS2
SI
SO
G0
(DEFAULT PRIM SET)
G1
(DEFAULT PDI)
G2
(DEFAULT CCP1)
G3
(DEFAULT MOSAIC)
ESC 2/4 (CF)
DESIGNATION OF G-SETS
CCP2
CCP1
ESC 2/4 2/9 (CF)
ESC 2/4 2/10 (CF)
ESC 2/4 2/11 (CF)
ESC 2/8 (F)
ESC 2/9 (F)
ESC 2/10 (F)
ESC 2/11 (F)
ESC 2/13 (F)
ESC 2/14 (F)
ESC 2/15 (F)
DRCS
MACRO SET
MOSAIC SET
PDI SET
SUP CHAR. SET
PRIMARY CHAR. SET
F CHARACTERS
7/11
7/10
7/13
5/7
7/12
4/2
CCDC CF:
3/0
3/1
G-SET REPERTORY

Figure 3 CODE EXTENSION OF 8-BIT ENVIRONMENT IN CVS

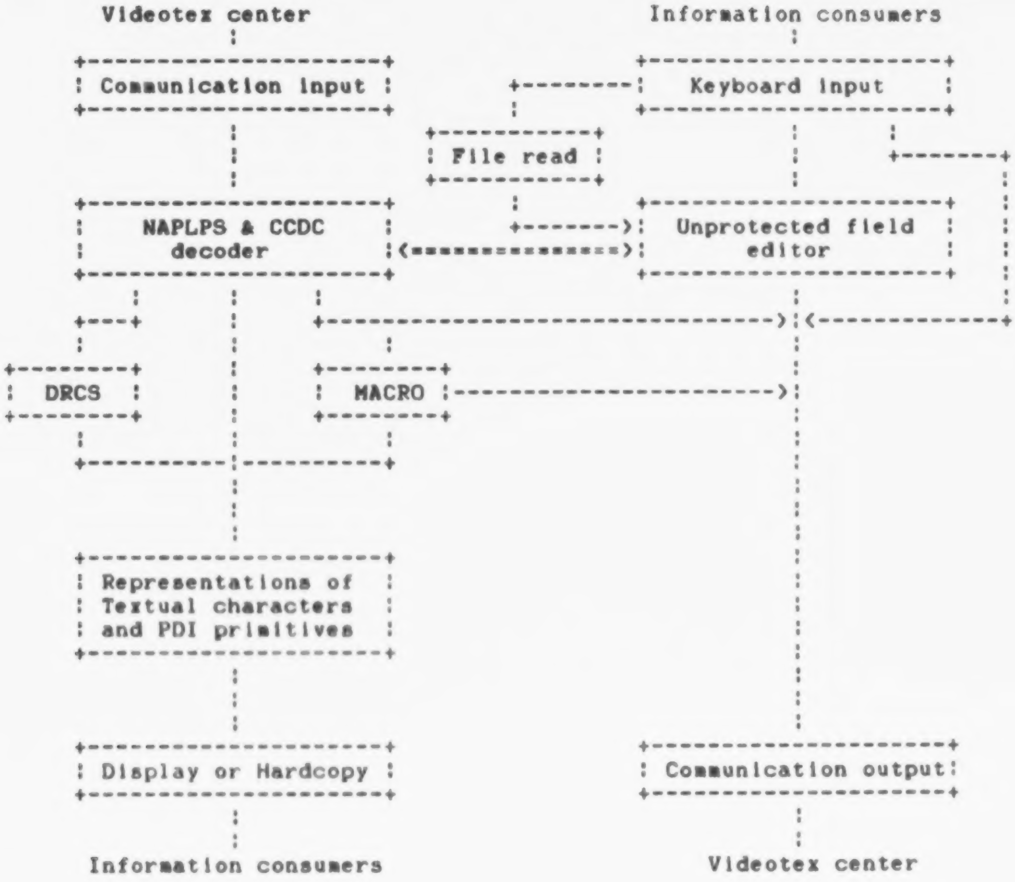
Videotex center
Information consumers
Communication input
Keyboard input
File read
NAPLPS & CCDC decoder
Unprotected field editor
DRCS
MACRO
Representations of Textual characters and PDI primitives
Display or Hardcopy
Communication output
Information consumers
Videotex center

Figure 4 SYSTEM FLOW DIAGRAM OF PC-BASED TERMINAL

- Due to the limitation of 4 simultaneous colors of IBM PC color display facilities, it can't support BLINK process and perform 16 simultaneous colors out of 512 obtained by color look-up table (color map). We use a palette of 2*2 matrix mask to represent 16 specified colors. So it is possible for color frame to be displayed in monochrome CRT with a little distortion.

4.2 HARDWARE CONFIGURATIONS

To implement the PC-based terminal, We use the IBM personal computer because of its popularity and availability. The hardware configuration which consists of IBM PC standard equipment is listed as follows:

- 128K RAM IBM PC or IBM PC-XT or compatible computer.
- Either monochrome CRT with monochrome/graphic interface card or RGB color CRT with color/graphic interface card.
- Videotex card.

The videotex card consists of the Chinese pattern repertory for CCDC, 128KB EPROM for application programn storage and asynchronized communication port which is compatible with IBM_PC asynchronized card. Each Chinese pattern is presented by a 16*16 dot matrix, and need 32 bytes for storage. Therefore 531,200 bytes are needed to support the CCP1 and CCP2. Application program storage can be used to store videotex terminal emulator and other application program.

4.3 SOFTWARE STRUCTURE

For the purpose of getting higher portability, the modularized structure is used in software structure design. Most of machine dependent modules have been identified, and can be modified easily to fit in different configuration.

As shown in Figure 4, there are three parts in system flow: NAPLPS & CCDC decoder, unprotected field editor, and input/output controller which includes devices drivers and communication driver.

The NAPLPS & CCDC decoder can interpret the coded information from videotex center and re-generate the corresponding picture through the presentation processes which include textual characters displaying, PDI graphic primitivies execution, and attribute control. The Chinese pattern fetch routine accesses the Chinese pattern repertory from the videotex card. While the MACRO/DRCS is called, the MACRO/DRCS routines execute the predefined operation. The result frame is displayed on the CRT, and user may have a hardcopy of the frame by pushing one function key.

The unprotected field editor on PC-based terminal can edit the data within the unprotected field and read the prepared file, which is created by the user locally, into unprotected field.

5. Conclusion

In CVS, most of the user's processing can be done locally. For example, using the PC-based terminal, Chinese and English word processing can be done completely on PC-based terminal. And user may retrieve required information and/or input proper information after online with CVS. The local intelligent functions of PC-based terminal will save the connection time and the usage cost.

Furthermore, the flexibility of PC-based terminal may automatically collect and process the data from remote databases through CVS. It will provide user a larger, multilingual information system by attaching easy-to-use software to a PC-based terminal.

6. REFERENCE

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Commercial Videotex Service (CAPTAIN) in Japan

- For the Visual Information Age

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NTT started the commercial CAPTAIN (Character and Pattern Telephone Access information Network) service in the Tokyo Metropolitan and Keihanshin (Kyoto, Osaka and Kobe) areas in November 1984. This service was expanded to the Nagoya area in March 1985, and five other major cities (Niigata, Kanazawa, Kumamoto, Oita and Beppu) in May. As of September 1985 CAPTAIN terminals totaled around 8000. The current service areas cover more than 40 percentage of total telephone subscribers in Japan.

1. Introduction

A number of visual information media have been developed, and trial or commercial services are being carried out either in community areas or in-house basis in Japan. Among these new media, The CAPTAIN (Character And Pattern Telephone Access Information Network, which is a type of videotex network system) service is a new communication medium which allows anyone to interact directly with computer-based information sources from their homes or offices, anytime, anywhere and at a low cost.

From December 1979 to July 1984, a trial CAPTAIN service was conduced in the metropolitan Tokyo area. The trial system had a storage capacity of 200,000 frames provided in the center, and 2,000 user terminals were installed on the premises of the monitors and information providers.

Following this trial service, a commercial CAPTAIN service was introduced in Tokyo Metropolitan area and Keihanshin area (around Kyoto, Osaka and Kobe) on 30 November 1984. The service was expanded to other major cities in 1985 and the current service areas cover more than 40 percentage of total telephone subscribers in Japan.

At the Council, first I would like to outline the purpose and history of the CAPTAIN service, including the current CAPTAIN network configurations, service functions and charges. Secondly, I would explain various problems to be solved, such as the price of terminals, information contents and retrieval method. Finally, I shall speak of future plans to develop visual telecommunication media and of those expected social impacts on the Visual Information Age we envision.

2. Features of the CAPTAIN service

(1) System Configuration

An outline of the CAPTAIN system configuration is shown in Fig. 1.

The CAPTAIN system is composed of three principal parts -- the Videotex Communication Network, information centers (the CAPTAIN Information Center and other external information centers) and user terminals.

(2) Outline of the Service

. Charges

User charges for CAPTAIN service consist of contract charges, communication charges and information charges. A detailed breakdown of all the charges related to CAPTAIN service is provided in Table 1.

. Terminal Equipments

User terminals, referred to as graphic terminals, consist of a telephone, TV set or other equipment with display (i.e., personal computers, word processors and data terminals) and CAPTAIN adapter.

CAPTAIN user terminals are available in five different specification levels to enable users to choose the type of terminal equipment that best fits their utilization needs (Table 2).

. Service Areas

As of October 1985, the CAPTAIN service is available to use in more than 100 cities in Japan.

. Service Function

CAPTAIN offers information retrieval service and three kinds of optional services (order entry, computing and Closed Users Group services). These services can also be combined to create compound services, enabling CAPTAIN to provide users with a truly wide selection of service offerings.

The explanation of each service is as follows:

1 Information Retrieval Service

A user can access a vast amount of updated information stored in computer centers at the touch of a button.

2 Oder Entry Service

Using CAPTAIN's two-way communication capability, a user can book flights and theater tickets, place orders, check bank accounts and transfer money.

3 Computing Service

Using nothing more than a basic CAPTAIN set, a user can perform a wide range of calculations and management functions -- for example, interest calculation, inventory management, and sales calculation and analysis.

4 Closed Users Group Service

With this feature, only specified users can access the database. This service has a wide range of applications, such as providing special information to a group of specified users, in-house communications, and order taking from specified customers.

3. Current Situation

The current situation of the service is as follows.

(as of September 30, 1985)

The number of user terminals	8,023
The number of Information Providers using CAPTAIN information center	527
The number of pages filed at the CAPTAIN information center	154,000
The number of external DF center	19
Average calls	about 1,000 calls/day
Average holding time ..	about 12 minutes/call
Average number of pages ..	about 40 pages/call

4. Problems and Their Causes

Although a year has passed since CAPTAIN service was commenced, the number of subscribers has not increased as much as had been expected. In fact, the service is widely believed to have failed to catch on and to be in a state of virtual dormancy.

Various reasons are pointed out for this situation. Surely a fundamental reason is the newness of the concept. People are not yet accustomed to such an advanced service, which integrates information and communications. Related to this, however, and more to the point, is that up to now no one has taken full responsibility for the service as a whole.

The standpoint of each of the parties involved can be summed up as follows:

NTT: "With some degree of apprehension, NTT accepted the social restriction that it would not deal with the content of the information provided by the service, and would not make or sell adapters, but would entrust this to manufacturers. Consequently, NTT considered its role simply as provider of the network and of the CAPTAIN Information Center facilities. It did not involve itself in such matters as reducing the price of adapters or improving the contents of the information provided."

Thus, the unfavorable impression was created that NTT did not really have its heart in promoting the service.

CAPTAIN Service, Inc.: (This company manages the CAPTAIN Information Center, which accommodates some 600 information providers (IPs) and 150,000 frames of information.) "The facility belongs to NTT, and the right of editing programs is held by the IPs. This leaves CAPTAIN Service, Inc. with little more role than that of caretaker of the building that houses the Center. We are powerless to take the initiative in gathering and providing useful information for users of the Center."

Information Providers: "The high price of terminals (formerly around U.S. $1,000), along with NTT's failure to become actively involved in promoting the service, have prevented the number of subscribers from growing. There are few outlets for the information, and so the service is not an effective way to reach customers."

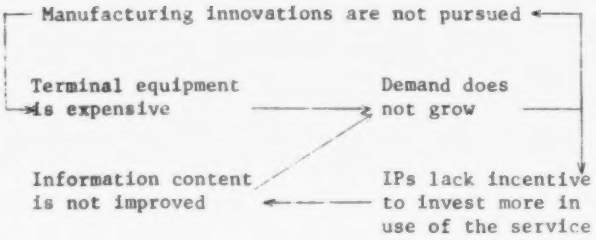
Thus, more attractive programs have not been created.

Manufacturers of equipment: "The information content is poor, and unrelated to the needs of users. Moreover, getting access to desired information is not easy. Until the service becomes more widely diffused, we are reluctant to invest more money in development of equipment."

Thus, the price of terminal equipment has remained high.

It is obvious that each of the parties involved in this new information communications service has made little attempt to take an overview of the service as a whole, but has stayed within the narrow confines of its own perceived role, nor has there been sufficient communication among the various parties.

The "dormancy" of the service has resulted from the combination of factors illustrated below:


Manufacturing innovations are not pursued
Terminal equipment is expensive
Demand does not grow
Information content is not improved
IPs lack incentive to invest more in use of the service

5.1 The "Million Strategy"

Out of awareness of this stalemated situation, NTT has recently embarked upon a bold new strategy. It is called the "Million Strategy," and aims to increase the number of terminals to one million in five years. More significant than this goal in itself is the change from a situation in which each party put the blame on others to one where NTT has taken the lead in attempting to make the service a viable one.

Concrete aims of the strategy include the following.

(1) Reducing the price of terminal equipment.

First of all, NTT has begun to deal with the high price of adapters, which has been a major obstacle to the spread of CAPTAIN service. It has taken the approach of purchasing large numbers of adapters (more than 10,000 units to date) and marketing them under the NTT brand naame, rather than leaving this to the manufacturers as before.

This measure has already had a great impact on the market, bringing about a price decrease from ¥200,000 to around ¥80,000 (under U.S.$400).

In addition, the terminal equipment marketed by NTT has functions that reduce the time and simplify the process of retrieving desired frames. The "auto dial" function enables the user to call up the Center simply by operating a key pad; and "one-touch dialing" calls up frames directly by the push of a button.

Starting from this foothold, it is hoped to increase the number of terminal units to 100,000 by 1987; and in the future, while bringing about further price reduction, the goal of 1,000,000 units by 1990 is to be accomplished by shifting the focus from the present use of adapters for TVs or personal computers to terminal units that are built into TV sets.

(2) Improvement of retrieval methods.

Users frequently have complained about the difficulty of using the current information retrieval system of CAPTAIN service. The main, interrelated aspects of this problem are (a) the system of classifying information, (b) the system of management of the information by IPs, and (c) cross-retrieval of information from several sources simultaneously.

In other words, the programs have been offered by the IPs individually, and there has been no way to line up all the information under one keyword across IP boundaries. Someone wanting information, for example, on "dinner shows" has had to call up each of the IPs who are likely to provide this type of offering, such as hotels, one at a time.

In an attempt to improve this situation, NTT has turned to an outside organization, which will make programs that are not limited to individual IPs. If this succeeds, it will be a big step toward the spread of CAPTAIN service.

For the future, it is hoped that a more logcial retrieval system can be devised than the present "tree-shaped" one. This is likely to take time, however; and it is doubtful whether a completely satisfactory system can ever be realized in this respect.

(3) Enhancing the content of the offerings.

A major reason the program offerings of CAPTAIN service have lacked appeal is that the IPs, most of which are large companies that have participated in the service from the trial stage, have tended to create programs that are largely self-promotional. Who wants to pay 30 yen to watch a three-minute commercial? Most of these companies are participating in the service for the time being only so as to avoid being "behind the times." In fact there is very little real information being offered at present.

While NTT remains hopeful that IPs will appear who are able to use CAPTAIN service to their own profit, or even depend on the service for their livelihood, meanwhile NTT continues to be restricted by not being able to offer programs directly, and by its lack of a sufficient data base. On the other hand, now that it has become possible for NTT to act as a sponsor, it intends to make a clear distinction between IPs and sponsors--and thus between information and advertising--and to promote the creation of programs that are unique to CAPTAIN, so-called CAPTAIN Specials.

CAPTAIN Specials might include such offerings as personal computer software (via downloading), map information, road information, horse racing odds, and specialized information such as for medical treatment. These are the types of offerings that are considered to have the most potential appeal.

5.2 The Form of Management

Accomplishing the aims mentioned above will be difficult if the current form of management is retained. The greatest difficulty is that CAPTAIN Service, Inc., in charge of the CAPTAIN Information Center, which accounts for over 80 percent of the use of the service, does not have the position of system operator, and even more importantly is not the total planner of the system.

If this service is to be developed freely and broad-mindedly, first of all it is necessary to make a clear distinction between the CAPTAIN System as a data base and the Videotex Network as a network service. Furthermore, CAPTAIN Service, Inc. must be given the right of ownership of the CAPTAIN Information Center, as well as the right to control content as a program provider; in other words, it must be allowed to manage the service as its own business, for which it is responsible.

In spite of NTT's efforts, the service remains essentially "masterless." It is to be hoped that giving control over to CAPTAIN Service, Inc. will allow that company to take charge of the overall strategy, resulting in significant improvement and development.

5.3 Future Development of the Service

From 1986, NTT will introduce a digital CAPTAIN sercice to meet the demand for a true-to-life colour picture, with voice information instead of the present character and pattern information without voice. At the first stage, the digital service will be commercialized on an in-house basis.

From around 1990, the service will spread widely via digital public network, replacing existing analogue CAPTAIN service gradually.

Further on in the future, such information will be included in the VRS (Video Response System) with moving picture information, using optical fibers.

6. Expected Social Impact of the Visual Information Age

Fig. 1 CAPTAIN System Configuration

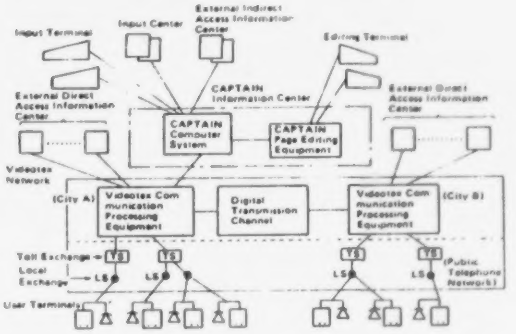
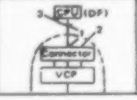
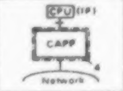

Input Terminal
Input Center
External Indirect Access Information Center
Editing Terminal
CAPTAIN Information Center
External Direct Access Information Center
CAPTAIN Computer System
CAPTAIN Page Editing Equipment
External Direct Access Information Center
Videotex Network
(City A)
Videotex Communication Processing Equipment
Digital Transmission Channel
Videotex Communication Processing Equipment
(City B)
Toll Exchange
TS
TS
TS
TS
Local Exchange
LS
LS
LS
LS
(Public Telephone Network)
User Terminals

Table 1. Detailed Breakdown of CAPTAIN User and IP Charges

User Charges	Contract charge	Communication charge	Information charge
	¥800	¥30/3 minutes	charge by IP

IP CHARGES (Levied by NTT)

	Item	By service: Videotex Network		CAPTAIN System Service						Remarks
	Input method	DF		IF	INC	IT	ET	Others		
		4800b/s 9600b/s	48kb/s	2,400b/s, 4,800b/s, 9,600b/s			Public Telephone Line	By MT or FD	Apply to the company for input	
Initial costs	Contract charge	¥800								
	Line installation charge	Per circuit ¥102,000	Actual cost	Per circuit ¥102,000			–	–	–	
	Equipment installation charge	Charges vary with the type of equipment					–	–	–	
Monthly charges / Circuit charges	1 Basic charge	Ref. other tariff					–	–	–	Circuit charges
	2 Connection charge	Per logical channel *1 ¥14,000		Per logical channel ¥30,000	Per circuit 2,400b/s ... ¥25,000 4,800b/s ... ¥50,000 9,600b/s ... ¥100,000		–	–	–	
	3 DCE usage charge	¥16,000	¥17,000	¥16,000			–	–	–	
Charge for facility usage	Frame fee	–		Up to 100 frames ¥11,000 Every 10 frames over 100 frames ¥1,100						Storage charges
	Input charges	–		–		· Update charge Every 10 frames ¥50 · Verification charge Every 10 frames ¥30	Per circuit ¥35,000	· Input charge Every 10 frames ¥490 · Update charge Every 10 frames ¥50	· Update charge Every 10 frames ¥50 · Verification charge Every 10 frames ¥20	CPU charges
Optional service charge	C.U.G. Service	–		Every 100 members ¥300						Standard Order File → IP can verify as to orders on line
Order entry service	Commodities file	–		Every 10 records ¥150						
Processing charge	Standard Order file	–		Every 10 orders per month ¥230						
	Simplified Order file	–		Every 10 orders per month ¥90						
	Computing service	–		Every 10 calculations per month ¥30						
Management service	Line printer output Type A	–		Every 10 lines of printer output per month ¥320						Simplified Order File → On line order verification are not possible
	Line printer output Type B	–		Every 100 lines of printer output per month ¥400						
	In a case of output to MT or FD			Every 100 records of output to MT or FD per month ¥200						
	Connection Pattern				CPU (INC) CAPF Network	IT CAPF Network	CAPE CAPF Network	Manuscript MT FD CAPF Network		

*1 More than 10 logical channels at 4,800b/s, 9,600b/s
More than 40 logical channels at 48Kb/s

Table 2. Types (Levels) of CAPTAIN User Terminals

Five levels of user terminals according to display functions.

	Level	Type		Functions: Pattern display	Coded data display	Alpha-geometric display	Resolution (dots)/No. of char's per screen		Ordinary TV display	Optional functions (○: standard, △: expanded): Multi color graphics (LUT)	Melody	Simple animation	Tele-software	Remarks
Home & Business Use	1	Pattern Terminal		○	×	×	Standard resolution	204 V × 248 H/ 120 KANJI or 496 alpha-numerics and/or KANA	○	△	△	×	△	Characters and graphics both displayed using pattern system. Display formation time is a bit slow.
	2	Hybrid Terminal		○	○	×	Standard resulution		○	△	△	△	△	Graphics display using pattern system; characters displayed using high-speed display formation code system.
High-level Applications	3	High-resolution Hybrid Terminal	Double resolution	○	○	×	High-resolution	204 V × 496 H/ 248 KANJI or 992 alpha-numerics and/or KANA	×	△	△	△	△	
			Quadruple resolution					408 V × 496 H/ 496 KANJI or 1,984 alpha-numerics and/or KANA						
Special Graphics Applications	4	Command Terminal		○	○	○	Standard resolution		○	○ (Only alpha-geometric displays)	△	△	△	
	5	High-resolution Hybrid Command Terminal	Double resolution	○	○	○	High-resolution	204 V × 496 H/ 248 KANJI or 992 alpha-numerics and/or KANA	×	○ (only alpha-geometric displays)	△	△	△	
			Quadruple resolution					408 V × 496 H/ 496 KANJI or 1,984 alpha-numerics and/or KANA						

Look Up Table (LUT): Function that enables IPs to choose any 16 of a possible 4,096 different shades for use in color graphics displays.

* When the function necessary to display a retrieved page of information is not resident in the terminal, a message to that effect is displayed on the screen.

BEST COPY AVAILABLE

A NEW CONCEPT IN DATA-ABOVE-VOICE (DAV)

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ABSTRACT

Data-Above-Voice (DAV) modems available today for use on telephone subscriber circuits transmit data well above baseband frequencies, usually from 40 khz to well over 100 khz. Signal attenuation at these frequencies is typically 1000 times greater than at voice frequencies. Although cross-channel interference has not yet been evaluated in a fully integrated network, it is a potential engineer's nightmare. This paper describes an equipment which avoids these problems by transmitting data in a narrow frequency band just inside, or just above, the normal 3.4 khz voice band. In this mode, data attenuation and data cross-channel interference are very well understood, since they are essentially the same as that for voice. Data rates as high as 1200 bps have been demonstrated in full duplex on a 2-wire telephone subscriber line, with little or no interference with voice communication on the same circuit.

INTRODUCTION:

Data-Above-Voice (DAV) modems available today for use on telephone subscriber circuits are capable of transmitting data from the subscriber's premises to the telephone exchange, provided that the exchange is less than 3 km away, although at least one manufacturer claims a range of 5 km. All use separate transmit and receive frequencies, separated by frequency selective filters. Both transmit and receive frequencies are 40 khz or higher, and modems are normally designed for attenuation of 50 db to 60 db on the line.

A survey of 1062 telephone subscriber lines in Auckland, New Zealand, showed the cumulative distribution of line lengths given in figure 1. Mean line length is 2100 meters, maximum 9781 meters. About 95% of all lines are less than 4.8 km in length, and 98% are less than 5.8 km in length (ref. 1).

Figure 2 shows a typical subscriber line, 4043 meters in length. Several cable splices are used, as is usual, and 3 different PCUT cable gauges are used. Signal attenuation versus frequency for this line is shown in figure 3. In this case, the maximum attenuation within the voice band is about 17 db, rising to about 45 db at 100 khz, and more than 50 db at 200 khz. Obviously, it is much more efficient to confine data frequencies either to the voice frequency band, or at least within the lower 10 khz region.

Modems have been built in the past to transmit low bit rate data (usually 50 bps) within the voice band, and some of these modems are still in use in New Zealand. Voice quality varies, but voice sometimes suffers due to high frequency filtering for data. The general feeling among telephone engineers seems to be that if voice can extend to a high of 2700 hz, then there is little or no sacrifice in voice quality. As this high frequency cutoff is lowered, however, voice quality starts to degrade rapidly, especially when the cutoff is reduced below 2500 hz.

There are a few higher bit rate modems which

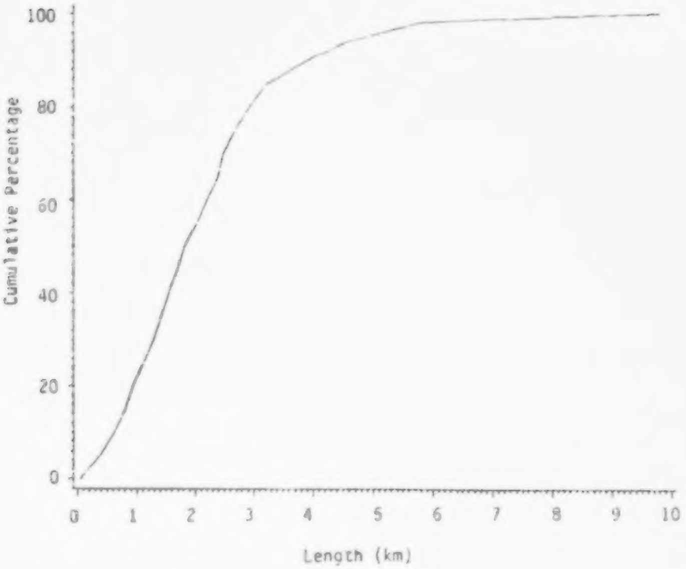

Figure 1: Cumulative distribution of line lengths for 1062 subscriber telephone lines in Auckland, New Zealand.

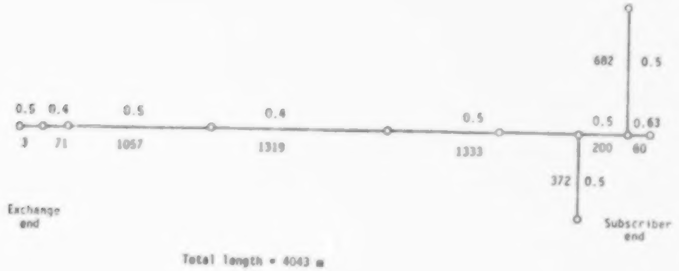

Figure 2: Typical subscriber line used as a model.

transmit data in a DAV mode with voice, usually in-band (below 3.4 khz). One such DAV modem is used by the New Zealand Electricity Division for transmitting data in their South Island network. Designed by Westinghouse, this modem transmits 200 bps FSK in a 300 hz bandwidth centered at 3 khz, with voice limited to about 2500 hz. Voice and data are then shared on voice channels on their Power Line Carrier (PLC) network, thus avoiding the necessity of designing additional circuits for data, since these circuits are very expensive.

Some time ago, at the request of the Manager of Communications, NZED, we began to look at the DAV system used in their network. They were having trouble with filter phase shift in the data band, causing reduced BER performance and compromises in the reliability of the data channel. In addition, they wanted to increase the data rate in the channel from 200 bps to 300 bps, with no increase in bandwidth allotted to data.

After analyzing the problem, we recommended a further increase in data rate to 600 bps, without increase in bandwidth, through the use of coherent Vestigial SideBand (VSB). We also recommended the use of zero phase shift filters throughout,

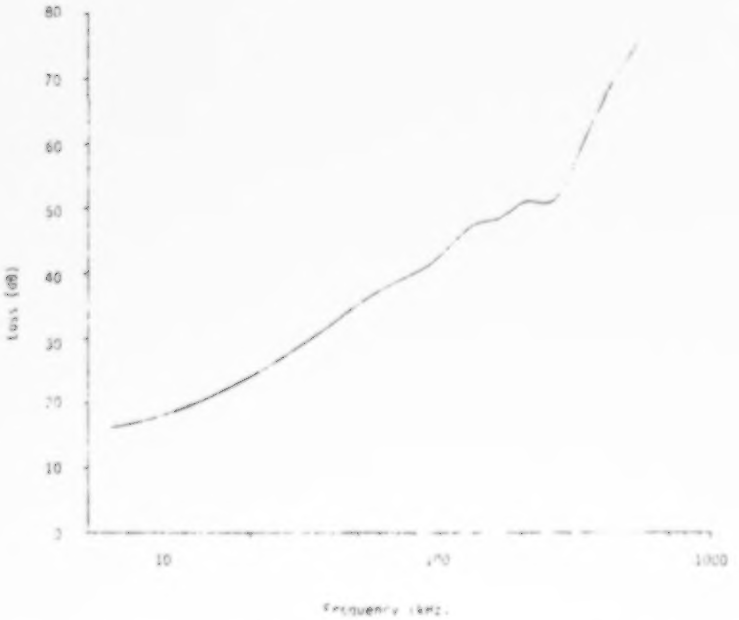

Figure 3: Frequency response versus attenuation for the subscriber telephone line shown in figure 2.

to improve the BER performance and increase the reliability of the data channel.

Later on, when it became obvious that 600 bps was a sound design for VSB at this bandwidth, NZED engineers requested a further increase to 1200 bps, still with no increase in bandwidth. This required adoption of a 4-level, 600 baud transmission mode, with a consequent reduction in BER performance.

The preferred data rate for 300 hz bandwidth is still 600 bps, and subsequent testing of the modem has verified that in the binary mode, performance closely approaches that of coherent QPSK. Bit rates for the NZED modem are 1200, 600, and 300 bps, selectable from a front panel switch.

DESIGN DESCRIPTION:

Designed to NZED specifications, this modem operated as a 4-wire device on the NZED PLC network, full duplex, at 1200 bps, with optional rates of 600 bps and 300 bps. Peak voice power level is 0 dbmo, while peak data level is set to -15 dbmo. Data covers the band from 2850 hz to 3150 hz (-6 db response). Voice is transmitted full amplitude from 200 hz to 2700 hz.

Figure 4 is a plot of the frequency response of the voice filter. Virtually identical transmit and receive voice filters are used, both designed for full amplitude response from 200 hz to 2700 hz. From 2850 hz, the voice filter provides at least 60 db attenuation for all higher frequencies.

Figure 5 shows the measured frequency response of the data transmit filter, obtained from a Hewlett-Packard Dynamic Signal Analyzer. As this plot shows, residual sidelobes from the data channel appearing in the voice band are lower than -70 db; however, since data are transmitted -15 db with respect to voice anyway, this is equivalent to lower than -85 db over most of the voice band. The modem in this respect exceeds CCITT specifications for toll quality voice, which calls for a noise level of less than -70 dbmo in the voice channel.

The data receive filter consists of a simpler

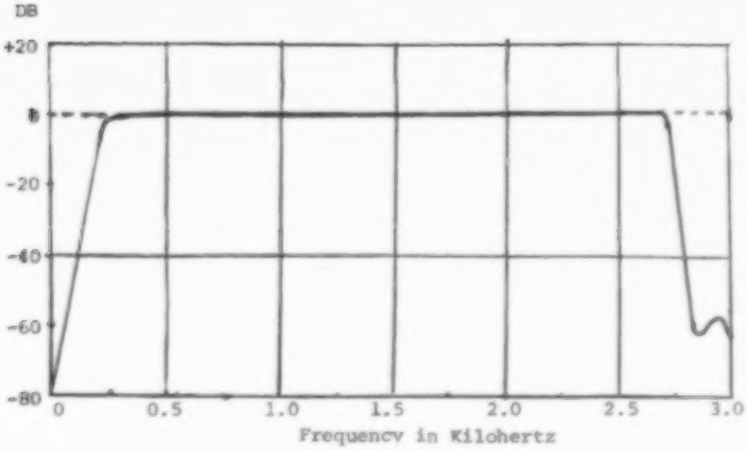

Figure 4: Frequency response of the voice filter.

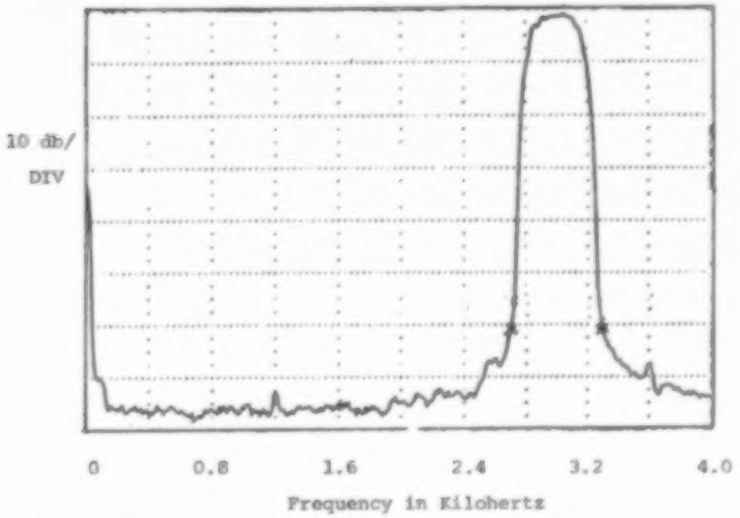

Figure 5: Measured frequency response of the data transmit filter.

design, since its sole purpose is to exclude voice from the data channel sufficiently to avoid bit errors. The frequency response of this filter is shown in Figure 6. The data receive filter is also designed for zero phase shift.

The final proof of any design, however, is governed by the opinions and the measurements made by the customer. In our case the New Zealand Electricity Division were kind enough to allow their engineers to make comprehensive measurements on our first modem models. Their measurements and comments on the design were most useful to us in improving the overall performance of the modem.

Figure 7 is a BER measurement curve made by NZED engineers on our first modem models. Performance at 600 bps and 1200 bps (4-level) are compared to the ideal performance of a CPSK demodulator. The BER performance at 600 bps is about as good as we could ever expect to achieve without coding.

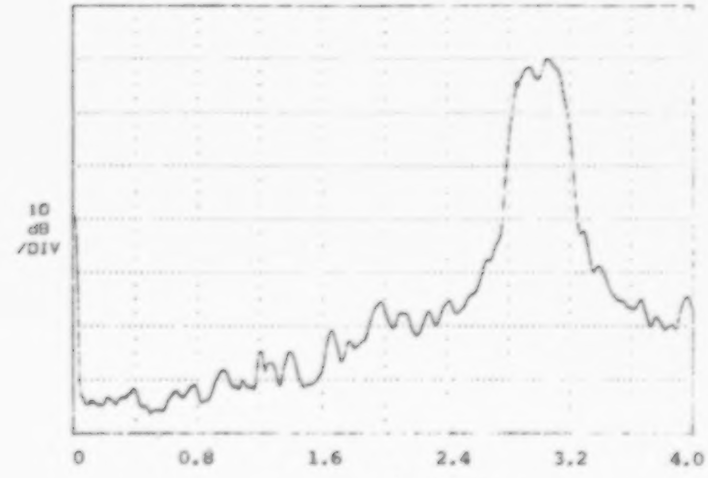

Figure 6: Measured frequency response of the receive filter.

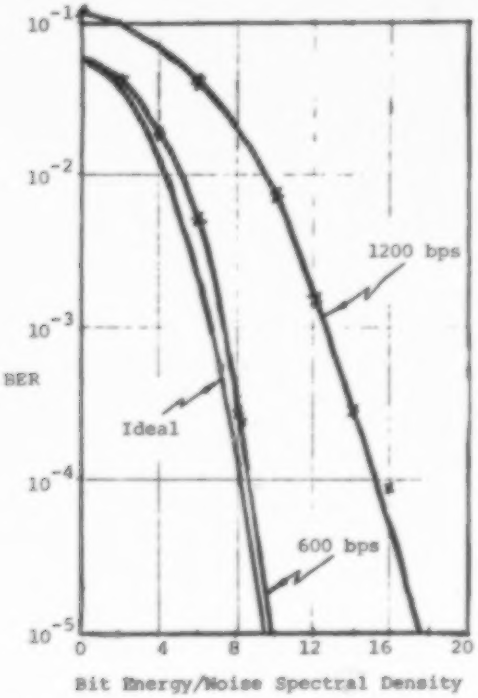

Figure 7: Bit Error Rate performance in noise, measured by New Zealand Electricity Division engineers.

Following NZED acceptance of our modem design, we have shipped additional models to Australia for use in a similar PLC 4-wire application. However, most customers want 2-wire modems, and it is always nice to have the capability of operating in full duplex mode. In response to this need, we designed a 4-wire to 2-wire conversion transformer hybrid, together with a simple feed-forward network to allow us to transmit and receive in the same frequency band. The narrow bandwidth of the data channel, together with the low line attenuation, makes it possible to use a relatively simple, single frequency adjustment, for 2-wire, full duplex operation on most 2-wire telephone subscriber circuits.

VARIATIONS ON A THEME:

Having proven the NZED design, a second design was tested, with the data channel extending from 3000 hz to 3600 hz. This gave 1200 bps in binary, and 2400 bps in 4-level operation. Voice in this modem extended from 200 hz to 2700 hz, as before.

Obviously, we can make the data channel as wide as we like, and place it where we like. A more important consideration, however, is what type of voice and data channel is acceptable both to the customer, and to the telecommunication regulatory authorities. Consultations with New Zealand Post Office engineers suggests that a data channel anywhere below 3.4 khz will not be permissible on the switched network; however, on leased lines it may be permitted.

A data channel presently under consideration for the public switched network is 3.6 khz to 3.9 khz. This allows full voice bandwidth to 3.4 khz, and leaves sufficient guard band for filtering.

There are additional considerations as well. If data are transmitted outside the voice band (3.4 khz), then data must be taken off the line at the local exchange and transmitted to its destination by alternative means. However, if data are transmitted inside the 3.4 khz upper frequency limit, then it may be transmitted as voice to any destination, so long as the destination of voice and data are the same.

Obviously many of these considerations go beyond our own abilities to resolve, but they must be considered by proper authorities.

Transmitting and receiving voice on the same wire pair has been with us for so long that we forget that this is possible only by impedance balancing in a bridge. When data are transmitted so close to the voice band, or within the voice band, then the same bridge balancing operation works equally well for data. Taking advantage of this fact, plus the very narrow bandwidth of the data channel, we designed this modem for both 2-wire operation and "frequency reuse", which means very simply that we transmit and receive on the same frequency.

Although 600 bps is a CCITT standard data rate, it is not as commonly used, for example, as 300 bps and 1200 bps. For this reason, we would like to be able to transmit 1200 bps in an acceptably narrow bandwidth, and certainly 300 hz is more acceptable as a DAV mode than is 600 hz. As an alternative to 4-level transmission, QVSB may be a consideration for future modems (ref. 2), as a means of achieving 1200 bps in a 300 hz bandwidth.

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MOBILE SATELLITE SERVICE APPLICATIONS IN ALASKA

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Abstract

Mobile satellite service, expected to be available within a few years, will have a broad array of applications. The new service will be made possible by a new family of satellites operating on UHF at high radiated powers. Applications in Alaska are described, and the results of a terrain shadowing study are presented.

INTRODUCTION

Dramatic technological developments are expected to make mobile satellite service (MSS) available in North America within a few years. The new service will make it possible to communicate with radios which are installed in vehicles (mobiles) or radios that can be carried in backpacks (transportables) virtually anywhere on the continent. It is anticipated that the impact on communication services in rural and remote areas will be substantial.

The Federal Communications Commission (FCC) is considering rules to authorize the new technology, which could be in service as early as 1988 or 1989. Before an operational system can be implemented, however, the FCC must allocate the necessary frequencies and license a system operator.

The National Aeronautics and Space Administration (NASA) has been working for some years to foster the development of MSS, and the Canadian government has been similarly interested. Twelve companies have applied to provide mobile satellite service in the United States (See Table 1). In the meantime, Canada is making plans to initiate its own service, and U.S.-Canadian cooperation is seen as a strong possibility.

Direct satellite-to-mobile service will be made possible by one or more satellites in geosynchronous orbit operating in the 800 MHz and 1.5 GHz bands with high effective radiated power. Narrowband, power efficient modulation techniques will be needed. Mobile units will need low noise receiver front ends and antennas with modest gain. Other ground stations, fixed or transportable, will be able to use the system if they have the same attributes.

The new technology should perform best in nonurban areas, where there will be few path obstructions. In urban areas, where buildings can cause path blockage and multipath problems, performance will not be as good. Mobile satellite service is seen as a way to dramatically improve many communication services outside metropolitan areas, filling the gaps left by present terrestrial systems.

SYSTEM STRUCTURE

Communication satellites transmitting radiated power levels high enough to be usable by mobile and transportable stations will make mobile satellite service feasible. Operation will be at UHF, in the 800 MHz range and, perhaps, at L-band (1.5-1.6 GHz). Direct communication links will be established between a satellite and: mobiles, transportables, gateway earth stations, base earth stations, and a control earth station. Each base earth station will serve a dispatch console, and each "gateway" will provide connection to the public switched telephone network. The control earth station, an operations center, will perform satellite and network control.

The network structure will accommodate four kinds of communication.

1. Mobile to mobile
2. Mobile to dispatcher
3. Mobile to public switched telephone network
4. Satellite and network control

The network must serve a large number of mobiles, a smaller but still large number of base stations and gateways, and the operations center.

Because UHF spectrum is in short supply, it is likely that UHF will be used only for communication with mobile units. SHF, either C-band (6/4 GHz) or Ku-band (14/12 GHz), will be used by base stations, gateways and the control station. It is possible that L-band will be used to serve some mobile units, and aeronautical mobiles in particular.

Mobile transmissions on UHF will be translated by the satellite to SHF and then retransmitted to a base station or gateway. Similarly, fixed station (base station or gateway) uplink transmissions on SHF will be translated to UHF and then retransmitted to a mobile. All mobile-to-fixed and fixed-to-mobile transmissions will involve a single hop, but mobile-to-mobile transmissions will require a double hop. One mobile's transmission on UHF will be retransmitted to the base station on SHF. It will then be switched at the dispatch console and transmitted back to the spacecraft on another SHF frequency, and retransmitted to the second mobile on yet another UHF frequency.

Satellite channels will be assigned automatically and dynamically as they are needed. Under this "demand assignment multiple access" (DAMA) approach, all functions will be performed automatically by user stations and by the operations center. The operations center will answer requests for channel assignments, make channel assignments, perform billing functions, and generally control the network.

A mobile or fixed station initiating a voice contact will use a common signalling satellite channel to automatically request service from the operations center and specify the unit being called. The operations center will assign a satellite channel from a pool of available channels and notify both requesting and called stations to switch to that channel. When the conversation is complete, the operations center will be notified so that billing functions can be completed and the channel can be returned to the pool.

The mobile satellite technology can also be used to provide data communication service. A packet-oriented service might be used to transmit sensor data, position information, or data entered from a keyboard. At low data rates, the service would probably be quite inexpensive. Under one concept, the operations center will interrogate all participating mobiles, base stations and gateways sequentially. Stations with data in memory awaiting transmission will transmit this data upon interrogation. The operations center will process the data as necessary and then send it on to the destination mobile, base station or gateway. Provision will be made for the operations center to process "alarm" signals not received in the normal interrogation sequence.

In order to make mobile satellite service technically feasible, the spacecraft must provide sufficient radiated power in the direction of the coverage area. Radiated power depends on the power available aboard the spacecraft and the gain of the spacecraft antenna. It is anticipated that, in the future, very large high gain antennas will be used to provide a multitude of spot beams, facilitating frequency reuse. First generation satellites, however, will involve more modest antennas and, at most, a few beams. A first generation satellite might use a 3 to 10 meter UHF antenna.

Circular polarization will be used because of Faraday rotation caused by the E- and F-layers, a significant effect at 800 MHz. Further, some degree of cross polarization isolation can be achieved using left-hand circular and right-hand circular polarization. This will facilitate frequency reuse in later generation systems.

Amplitude companded single sideband (ACSB) may be the voice modulation technique selected for mobile satellite service ("Compand" means compress-expand). Using this technique the modulating signal is compressed in amplitude prior to modulation at the transmitter and expanded following demodulation at the receiver.

Compression of the modulating voice signal reduces its dynamic range but also keeps the average modulation level high. Expansion restores the dynamic range of the demodulated signal and produces a replica of the original modulating signals, degraded of course by noise. Because of the relatively high modulation level and the quieting effect of the expander during pauses in speech, the subjective degradation due to noise in a companded channel is less than in an uncompanded channel.

ACSB modulation provides signal-to-noise performance that is superior to SSB without companding, but retains SSB's advantages for mobile satellite service. Specifically, it needs only small channel bandwidths (4 or 5 kHz).

APPLICATIONS IN ALASKA

A number of promising state government applications in Alaska have been identified. These can be divided into three categories: communication with vehicles on the highway system, communication with remote locations, and other communications.

Vehicles on the Highway System

The Department of Public Safety and the Department of Transportation and Public Facilities (DOT&PF) both have major needs for communication with vehicles operating on the highway system, the former to support the Alaska State Troopers and the latter to support highway construction and maintenance operations. In addition, ambulances, which are not state vehicles, also have a critical need for such communication. Two-way voice communication with a dispatcher is needed in all cases. In addition to the above vehicular needs, it would be helpful for project engineers on DOT&PF construction sites to have telephones. Further, MSS will make possible emergency roadside telephones in remote areas.

A two-way voice communication system is presently operated by the Department of Administration's Division of Telecommunications Operations. This system uses VHF radio, in conjunction with a microwave relay system, to provide highway coverage. Although most areas of the highway system presently have adequate coverage, significant gaps exist along some highways.

It is possible that MSS can be used to fill in some of the existing gaps in coverage. It is also possible that, in the future, MSS will provide a more cost-effective and/or reliable communications system than the one presently being used.

Remote Locations

The Department of Fish and Game and the Department of Natural Resources both have significant requirements for communication with field personnel in remote locations.

Fish and Game operates about 100 temporary camps each year. These are staffed by biologists and other field personnel. The camps are operated in connection with fish counting and other management and research activities. Fish and Game also operates a number of vessels in conjunction with the same activities. All of these require two-way voice communication. The availability of telephone service would also be desirable in many situations. No present data communication requirement has been identified, but this may be needed in the future in connection with data entry and data access.

Two-way voice communication services are presently provided to remote Fish and Game personnel through the use of a variety of systems, depending on individual circumstances. In truly remote situations, single sideband radio, which is often unreliable, is the only option. MSS, on the other hand, has the potential to be a single, reliable communication system for use by temporary camps, boats, and research and management personnel located at permanent facilities.

Within the Department of Natural Resources, the Division of Geological and Geophysical Surveys and the Division of Forestry both have the need for communication to remote locations. Geological and Geophysical Surveys operates remote seismic monitoring stations which transmit low speed data. These must presently be located so that they can be connected by VHF to existing microwave facilities. MSS could also provide the communication link, and with MSS, the stations could be located virtually anywhere.

The Division of Forestry has responsibility for firefighting over the southern part of Alaska. Firefighters very often work in remote locations, and they have the need for two-way voice communication with their dispatch centers. The need to communicate is obviously quite critical. Various systems are presently used, depending on circumstances. MSS has the potential to substantially improve the ease and reliability of these communications.

Other Candidate Applications

Ships operated by the Marine Highways System, within the Department of Transportation and Public Facilities, have the need to communicate with shore facilities. Voice communication, presently provided through the Coast Guard VHF system and through single sideband radio, is considered generally adequate, but there are some gaps in coverage between Seattle and Ketchikan. The Marine Highway System is interested in expanding its computer-based reservations system to include computer terminals and personal computers located aboard the ships. These must be linked, through a data communication circuit, to a computer on shore. MSS appears to be an ideal way to provide the necessary data communication link.

The Division of Emergency Services, which is within the Department of Military and Veterans Affairs, has a need for communication services when disasters occur. If other communication facilities are unavailable because of disaster conditions, MSS appears to provide an excellent way of establishing the vital links. Single sideband radio is presently used, but, as mentioned above, its reliability is not always adequate.

SHADOW ANALYSIS

Even if Alaska is illuminated at adequate power levels by an MSS spacecraft, effective utilization of the spacecraft can be disrupted by terrain shadowing. This phenomenon will occur when terrain features block or disrupt the radio path between the spacecraft and the mobile or portable unit. Shadowing has the potential to be a serious problem for Alaska because, at northern latitudes, communication satellites in geosynchronous orbit appear at low elevation angles; i.e., they appear close to the horizon.

The shadowing problem has been studied carefully by means of a graphical technique which uses topographic maps. The results of this work indicate that shadowing is not likely to be a serious problem on most of the Alaska highway system or on the Alaska Marine Highway System.

Graphical Analysis

In order to estimate what fraction of the highway system and the Marine Highway System will be shadowed, a special graphical analysis technique was developed. The technique uses a set of rulers which can be used on standard topographic quadrangles available from the U.S. Geological Survey. The rulers take into account the properties of radio propagation and enable one to quickly determine whether a radio path exists between a particular point on a map and a spacecraft in a particular orbital position. When the results are "borderline," a pessimistic approach is used, and it is estimated that shadowing will occur.

This technique has been used to check for shadowing problems on the state's highways and on the Marine Highway routes. An orbital position of 125°W has been assumed. This is a favorable position for Alaska but not the most favorable position (proposals range as far west as 136°W). Orbital positions further east will give more shadowing, and those further west will give less shadowing.

As indicated in Table 2, for most of the state's highways, only a small fraction of total mileage is hidden from view if the spacecraft is located at 125°W. Exceptions are the Dalton Highway -- an estimated 17.3 percent of its length will be shadowed -- and the Seward Highway -- an estimated 13.2 percent of its length will be shadowed. It is estimated that 7.1 percent of the state's total highway mileage will be shadowed.

The Alaska Marine Highway System routes were examined using the same graphical technique, and with one exception, no shadowing was found. The exception is in the Gastineau Channel near Juneau, where there is a possibility of shadowing.

In order to evaluate the accuracy of the graphical technique, the Parks and Seward highways were field checked for shadowing using a compass and an inclinometer. The field results are compared with the graphical results in Table 3. For both highways, field measurements gave fewer shadowed miles than graphical measurements. This is consistent with the pessimistic approach described above.

During the field work, it was noted that, in some cases, small terrain features close to the highway had been missed by the graphical procedure. This happens when the terrain feature is smaller than the contour interval of the topographic map used. In some cases, these features cause shadowing undetected by the graphical technique.

In light of these results, the graphical analysis provides a reasonable, but far from precise, indicator of shadowing difficulties.

CONCLUSION

This new technology has the potential to dramatically improve the way telecommunications services are delivered in rural areas. Such diverse services as rural telephone service and communications for air traffic control amy be affected. Although first generation systems will have limited capacity, frequency reuse in later systems will substantially increase capacity and may make mobile satellite service ubiquitous in rural areas.

There are no major technological barriers to institution of an operating system in the next few years. Spectrum availability is the major obstacle, but the FCC's recent action is seen as a strong indication that the necessary frequency allocations will be made.

TABLE 1. Characteristics of Proposed Systems.

Applicant	800 MHz	1.5 GHz	Proposed orbital positions (degrees West longitude)
Global Land Mobile Satellite, Inc.	Yes	Yes	94°, 129°
Globesat Express	Yes	No	*
Hughes Communications Mobile Satellite Services, Inc.	Yes	Yes	135°
MCCA American Satellite Service Corp.	Yes	No	66°, 96°, 126°
McCaw Space Technologies, Inc.	Yes	Yes	101°
Mobile Satellite Corp.	Yes	Yes	85°, 125°
Mobile Satellite Service, Inc.	Yes	Yes	85°, 125°
North American Mobile Satellite, Inc.	Yes	No	One position between 120° and 130°
Omninet Corp.	Yes	Yes	89°, 119°
Satellite Mobile Telephone Co.	Yes	Yes	75°, 120°
Skylink Corp.	Yes	Yes	75°, 136°
Wismer & Becker Contracting Engineers/ Transit Communications, Inc.	No	Yes	80°, 113°

* Uses 50 "small, inexpensive" satellites in random, nongeosynchronous orbits.

TABLE 2. Shadowing mileage estimates.

Highway	Estimated mileage shadowed (miles)	Total highway mileage (miles)	Percentage of miles shadowed (percent)
Alaska	3.25	232	1.4
Dalton	72.0	416	17.3
Edgerton and Copper River	7.5	81	9.3
Elliott	5.5	152	3.6
Glenn	15.0	189	7.9
Haines	0.0	87	0.0
Parks	11.7	323	3.6
Richardson	23.0	364	6.3
Seward	16.75	127	13.2
Steese	9.0	162	5.6
Sterling	4.0	136	2.9
Taylor	10.0	161	6.2
Tok Cutoff	2.5	125	2.0
TOTALS	180.2	2,555	7.1

TABLE 3. Shadowing mileage field results.

Highway	Shadowed Mileage			Percent of Mileage Shadowed	
	Field measured (miles)	Estimated (miles)	Total mileage (miles)	Field measured (percent)	Estimated (percent)
Parks	9.3	11.7	323	2.9	3.6
Seward	15.2	16.75	127	12.0	13.2
TOTALS	24.5	28.45	450	5.4	6.3

Luncheon Speaker

"Answer the Echo/Follow the Dream –
Life Styles and Deep Space"

James A. Dator, Secretary General,
World Futures Studies Federation

Notes

Answer the Echo/Follow the Dream--
Life Styles and Deep Space

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Abstract

If humans can avoid their most likely current trajectory towards the future--military or economic holocaust--then the combination of the electronic, biological, and space revolutions suggest not just that humans are in the process of encountering novel environmental pressures in space but that we may be in the process of creating our own intelligent successors.

Today I intend to say some things which will make you hopeful and optimistic about the future. If I am to be honest, that is no easy thing for me to do. The reasons to be despairing and fearful far outnumber the evidence for hope. There is no need to account them all. I must presume you know them. I am of course referring to many things. For example, reflect on the utterly mad military, foreign, and domestic policies which are being followed by governments, and which apparently are blessed, or at least accepted, by so many people around the world. How could anyone truly believe that the money, time, and talent being put into the preparation for war is in any way justified except in the most greedy, selfish, or shortsighted terms? Because we focus so much of our attention and energy on military preparedness, we certainly are letting a thousand and one other problems--and opportunities--creep up and slip by unnoticed and unanticipated, and with us wholly unprepared.

Consider the fact that America, during the Reagan administration, has become the world's leading debtor nation. The past six years of increasingly unbridled greed--which has been sold as a time of great "prosperity"--have been bought not only by robbing those of us who refuse to believe that the primary focus of life should be the endless accumulation of personal wealth. More importantly, it has been bought by robbing the future. It is a conditon beyond conscience and decent ethics--done of course in the name of God and good morals--and it has resulted not in ending the dreaded "welfare state" but only in replacing the recipients of the welfare from being the truly needy in societies to being the most wealthy, privileged, and militaristic. As the slogans on American television endlessly say, "Be All You Can Be In The Army!" "We're Not A Company; We're Your Country!" That is fascism glorified.

But I said this was going to be a hopeful talk. Still, I have to warn you that even my message of hope is not that everything is A-OK. I can not tell you that we can just lean back on our sturdy past values and virtues and sail effortlessly into a golden tomorrow. To the contrary, what I see, and what I see as hopeful, is this:

The industrialized and industrializing parts of the world are in the midst of a major social transformation. "The Future" which the old futurists of the 1960s told about--Buckminster Fuller, Marshall McLuhan, John McHale, Robert Theobald, Alvin Toffler and the rest--this future is here. It is now. But we seem even more stunned by our Future Shock than anyone suspected we would be. We seem to be moving into the future while staring resolutely at the old rearview mirror and calling that tarnished reflection of the past, "the future."

There are many forces transforming our old world. Many are technological, others are political, some are structural, and some are based on demographic or resource factors. I intend to mention some of the technological forces, and to focus at some length on one that might be called "techno-political" because it requires, more than some of the others, that a substantial number of political decisions be made in certain ways in order to invoke the transforming power which the technology will then exert.

The driving technological force of the present and the immediate future is that which brings you to this meeting this week. It is the electronic revolution--the combined technologies of telecommunications, robotics, automation, artifical intelligence and the rest. Absolutely no social institution of the present, including your family, your religion, your community, your job will be untouched by this. They all will emerge in the early 21st century--if not well before--in a form, and performing functions, quite different from those of the present and the remembered past.

The likely consequences of the electronic revolution seem not to be seriously contemplated, much less well understood, by most people currently responsible for our public policy. Moreover, judging from what I hear young people say about their plans (or lack of them) for, and expectations of, the future on the one hand, and the almost complete absence of serious consideration of the issue by our major political and economic decisionmakers, I would say that this factor of transformation is "invisible" to most people, if not to you.

It is not as though there were not plenty of information about it. It is no doubt being discussed extensively at this Conference. Our libraries also are full of books and articles which seem to me to state quite clearly the magnitude of the personal and social consequences of the electronic revolution. Given this, it is a mystery to me why we can focus so much on such personal problems as sex, abortions, drugs, and drunk driving, on the one hand, and on obsolete ideological conflicts, on the other, while we essentially ignore the real revolution that is occurring at this very moment all around us.

I do not propose to talk much about the electronic revolution today, nor about the biological revolution that will follow very shortly in its wake, and which will have even more profound, substantial, and invisible transforming influences over us.

No, today I wish to talk about space--about living in space, and about what living in space is likely to mean not only to those of us who remain earthbound, but to those who are willing and able to kiss mother earth tenderly goodbye and finally leave the cradle.

In a letter to the British Interplanetary Society on the occasion of its "Space '84" Conference, Arthur C. Clarke wrote this: "The earth is a cradle which, by the 21st Century, Man will have outgrown. Soon, even the most visionary of our present thoughts will seem commonplace--as we adapt to our new environment and take our first steps on the road to the stars." (1) It is a consideration of the variety of implications of that statement that will be my message of hope to you today.

Twenty years ago, when I first concerned myself professionally about the possibility of humans living in space, the future of such a venture looked bright indeed. I still have a little collection of publications from the mid- to late 1960s dealing with the social implications of deep space travel and living. For example, S. B. Sells, of Texas Christian University, at a conference on "Stepping Stones to Mars," in March 1966, described "A Model for the Social System for the Multiman Extended Duration Space Ship." (2) He opened his discussion by saying, "This report is part of a research program undertaken in anticipation of a need for behavioral science principles related to crew adaptability in the microsociety of extended space missions. Current analyses by space scientists at Boeing, Douglas and General Dynamics of the timetable for manned flights to Venus and Mars estimate the earliest flyby of Mars between 1973 and 1977 and landing between 1982 and 1986."

That was a pretty good estimate for an unmanned flyby, but too conservative for a landing—if you count those intelligent silicon successors to homo sapiens who nearly celebrated July 4 on time by landing on Mars and then proceeded to tell us some rather depressing things about life on the Red Planet. But Sellers obviously was interested in manned, and not roboted, space flight design, and no such manned flights or landings have yet been attempted on Mars or anywhere else. Indeed, during the 1970s, the future of such flights seemed doomed.

A 1980 publication by NASA said, "Space settlements are no longer being studied by NASA; establishing settlements in space would be very costly; there is within NASA no recognizable need for a space settlement project now or in the near future; and NASA has no plans at this time to establish a space station on the lunar surface." (3)

Then in his 1984 State of the Union Address, Ronald Reagan called for NASA to establish a permanent manned space station in the near future. Though the political infighting surrounding this call is still going on, with a victory for NASA by no means assured (and while the rationale Reagan used for the space station was unfortunately that of military necessity), interest in the social, as well as economic and technological, aspects of space settlements has recently been renewed.

NASA sponsored a study of lunar bases in the summer of 1984, and, with the National Academy of Science, two symposia on space activities in the 21st century in the Fall of 1984 and the summer of 1985. Many private sector meetings on the economic benefits of privately-financed and directed space settlements have also been held within the last several years. Most countries which are capable of launching or participating in space activities have held their own meetings recently, and the United Nations got fully into the act with its UNISPACE conference in 1982.

So assuming that something good might come of all this, let me turn to a consideration of some of the alternative sequences in the future development of manned space flights that could create interesting, and possibly unique, social situations for humans to experience, and to anticipate, plan for, and/or study.

The sequences of "A Scenario for Extraterrestrial Space Humanization" suggested by William MacDaniel in 1982 (4) are as follows:

1) The use of a current space shuttle craft as a geo-stationary orbiter.

2) The construction of a Space Operations Center, which would house four to twelve persons for stays from 90 to 120 days. Everything would be sent up from earth, and ground stations would attempt to exercise complete or final control over the persons on board.

3) A Low Earth Orbit Base. The original purpose of such a base might be to build the giant solar reflectors suggested to supply concentrated solar energy to earth in the late

70s. Or they might have some military or other purpose. These LEO bases would be semi-self-supporting, and have a larger, and semi-permanent, population living on them.

4) A Moon Base. This would be almost entirely self-supporting, and ideally would export material or services to earth (and elsewhere). With such a base would come, sooner or later, whether planned or not, a moon-rhythmed society, with moon-appropriate life-styles, practices, and beliefs. Moon-born and bred children would soon appear.

5) A Space Manufacturing Facility is the next likely development MacDaniel posits. This will be a wholly-designed habitat, freed of even the moon's limitations and differences, and certainly freed of any of those of earth. These facilities are likely to be placed in one of the so-called "L-5" positions which are in between the gravitational pull of the earth and the moon. Their task would possibly be to serve as zero-gravity manufacturing bases or the like.

6) These Space Manufacturing Bases would likely soon develop into full Orbiting Habitats which would enable a rich panoply of behavioral opportunities--everything humans do on earth, and much, much more.

7) And finally, we can hope to see the development of deep-space starships, headed first, perhaps for the planets, but eventually to boldly go where no one has ever gone before--as far as I know.

That is the way William MacDaniel sees it might be. Let me suggest some alternative, but related possibilities. For one thing, we might ask who might come to move into space, and why they might come to be there.

1) Militaristic/Nationalistic. The first and most obvious reason, given our current pre-occupations, would be to serve military and nationalistic purposes. America has to do these things to keep ahead of, or and least up with, the Russians. It also needs to do it in order to show how great it is. It is a matter of national, and self, pride. "We do it because we can, and because we can, we must." The Soviet Union must be thus motivated,and other nations might have a similar imperative. Even some nations who apparently do not feel this urge at present might join the race. Certainly the European space consortium, Japan, China, and India are strong contenders, but so also we might find Pakistan, Indonesia, Brazil, Argentina, and many more nations able and willing to leap off the Little Blue Marble for reasons of national pride or militaristic impulse.

2) Entrepreneurial/Adventuristic. Already we know that businesses in the United States and elsewhere are contemplating privately-financed and directed manned space programs. If the "magic of the marketplace" continues to be unleashed, we might see many more such activities in the US, and elsewhere in the world. This could possibly become as free, glorious, and unrestrained as the sailors and pirates who sailed the seas of earth from ancient times until only 100 years ago. So even if NASA and other governmental efforts fade, private enterprise may shine.

3) Religious/Cultic. Perhaps closely related to the nationalistic or the entrepreneurial impulse will be the desire of some religious or mystic group to leave the confines of earth for life in another Great Beyond. The impulse which led the Pilgrims to America, or Joseph Smith to Utah, might move Muslims into space. Or we might see some true "Moonies" indeed. Praise the Launch!

4) Erotic/Emotional. But there are other reasons for wanting to blast off. As the censors and the narcs seem in the process of re-Puritanizing the place, why don't we take our drugs, X-rated movies, and sex-tours into outer space? Let's leave Disney World for the kids and families here on earth, and head on out for a magical mystery tour.

5) Random/Probabilistic. Finally, since we should free ourselves from the Newtonian physics and logic of the earth anyway, why not choose the people who will go into space on a random basis? Let's give everyone who wants to go--and even those who don't, perhaps--a chance. Use a table of random numbers, and let the inhabitants make up their reasons for being there themselves. This final reason for leaving seems to fit well with one of the explanations most frequently encountered in science fiction as to why our developing the capacity to live in space is not some idle dream: we may need to escape from earth in order to avoid some earthly catastrophe, whether it be the Greenhouse Effect, a Nuclear Winter, or the return of the bombarding meteors.

Perhaps a random sample of humanity could be launched in Spaceship Ark to avoid some cosmic flood and to begin to be fruitful and multiply all over again. Why knows? Perhaps it has happened before.

I draw three conclusions from the survey of who might settle in space and why they might settle there:

1) While the United States and the Soviet Union are the current main contenders in the space race, it would be wrong to assume that they will continue to monopolize the action. Other political actors, some currently far behind in the running, are likely to leap to the fore. Such a development could greatly influence the cultural style of space settlements. This is also likely to be the case of any multinational space settlement project--and many observers contend that any large project will almost certainly be multinational rather than carried out by single nations. The current space station envisioned by NASA is being planned in cooperation with the European Space Agency and Japan, and probably also with India, China, and the Soviet Union. Voyages on the scale of worldships might require virtually global cooperation.

2) But we should not focus our attention on national and international space programs and fail to understand the likely role of non-governmental groups--religious, ideological, entrepreneurial, as well as hedonistic. As in the past, so in the future, groups such as these

might be able muster the energy and resources of larger numbers of people than will our dying nation-states, and thus be the source of future massive programs of all kinds, including space habitation.

3) The experience of living in space will not be merely an extension of our living experiences and styles on earth. It will be qualitatively different, and thus influential in producing new human beings.

But now we are getting a bit ahead of ourselves. So let me next speculate on some of the possible social structures of a sizeable, permanent, self-sufficient space community--something in the range of a moon base, space manufacturing facility, and beyond.

Ellwyn Stoddard makes the case for the inevitability of a militaristic social system for any space community. (5) As he puts it, "future space colonization will be accomplished only under the most disciplined structures rather than providing for unlimited personal freedom envisioned by many science fiction and liberal authors." He titles one section of his essay, "The 'Liberal Tradition': A Non-viable Ideology for Space Planning," and complains about the "liberal bias of most commentaries about futuristic societies." Instead, any space society "must be dictatorial," he insists. It "must involve the military model." "Quite plainly, the Third Wave institutions [envisioned by Alvin Toffler and others] could not survive in space communities...," he maintains.

Stoddard makes a strong case for the necessity of a non-liberal polity in space, and current and planned models follow a militaristic model more or less closely. But I believe an even more convincing case can be made for freedom over authoritarianism as the basic design objective for a space settlement.

When B. J. Bluth analyzed the behavior of American astronauts and Soviet cosmonauts she found that a significant number of instances of insubordination by crews had occurred in space. (6) The starfarers of both countries have concealed events from ground control, brought contraband aboard, or failed to carry out orders. Even the most well-trained from both quite militaristic societies, and under the dangerous conditions of space, have found it necessary, or desirable, to act out and to express their individuality. Can we expect any less from crews in the future, especially if they are part of non-national or international missions?

Of course, questions of individual deviance are one thing. Acts of political rebellion would be something else. What is the likelihood of that? James E. Katz reviewed the history of colonization on earth in relation to the settlement of space stations. He reminds us, for example, of the bitter conflicts which emerged between the owners of the Virginia Company in London and the people who actually settled in the wilds of far-away Virginia. Life in Virginia was so different from that in London that what seemed reasonable in one place was outrageous in the other. As we all know, these differences eventually led to the American Declaration of Independence, the Revolutionary War, and the Constitution of the United States. Katz reviewed many other similar instances of colonial rebellions in earth's history. (7)

These actual experiences of insubordination in space, and the reminders of the historical difficulty and eventual impossibility of colonizers retaining control over distant colonies on earth, suggests that it is not likely that the residents of any substantial space community will long adhere to the mission for which they were originally sent into space. They will develop minds, and wills, of their own which will soon put them into conflict with attempts at earth-bound control.

But there are additional reasons to believe that a desire and attempt to be free of earth control will soon be experienced by space settlers.

William MacDaniel has a helpful analysis which indicates how some apparently minor differences between the habitats of space and those of earth could lead to major differences between the two. (8) For example, there will be no forests in space. This means that paper will be expensive and scarce, and thus that information almost certainly will be stored electronically. This means that people will not need to congregate to process information. "This will include libraries, schools, offices, banks, publishing houses, newspapers, city and county clerk offices, and perhaps legislative and judicial facilities," he suggests. The consequence of this might be a "lessening of face-to-face secondary group communication patterns in favor of electronic communications." This could lead to "entirely different attitudes towards work, fellow workers, company loyalties, and work scheduling; this can also apply to education.... Family norms and behavior patterns" may differ so much that "the extraterrestrial family is likely to differ considerably from the terrestrial family in terms of functions, norms, attitudes, values and behavior patterns; and the traditional Earth family system, if transported intact to space, may be highly dysfunctional in the extraterrestrial environment," MacDaniel concludes.

A similar set of divergencies between life-styles on earth and in space can be anticipated if we reflect on how much of human behavior is conditioned by the fact of a 24 hour day on earth. This cycle will not exist naturally on the moon or on other habitats constructed in space, although attempts might be made initially to export or impose it for the benefit of the earth-bound.

On the other hand, it must not be forgotten that patterns of social life on earth will continue to change as they always do. This could result in the sort of behavioral and value lag frequently seen between colonies and their "motherland" on earth: the colonists hold on to lifestyles long after they are abandoned at home. For example, it is frequently said that the values and behaviors of the descendants of Japanese immigrants presently living in Hawaii more closely resemble those of Japan of 100 years ago than of Japan today.

In any event, it is likely that the social patterns and individual beliefs of humans in space will diverge rapidly and surely from those of humans on earth. It seems almost certain then, that the space settlers will soon wish to define their lives in their own terms, and not on the basis of some predetermined "mission" from earth.

But even more exciting possibilities have been identified. A University of Hawaii anthropologist, Ben Finney, and his associate from the Los Alamos National Laboratory, Eric Jones, have used the experiences of ancient Polynesian seafarers to speculate on the divergent evolution of homosapiens, earth-bound and space-freed. They note that the hereditary leadership system which is typical of Polynesian culture evolved from the economically-successful "Big Man" leadership system (which is still found in parts of Papua New Guinea) because the environmental pressures of small-island and seafaring environments were so different from those of the vast mountains and plains of the original "Big Man" cultures. What was quite appropriate for one environment was not suited to the other, and as new social forms emerged which satisfied the new environmental needs. Might there not be similarly unusual pressures in space, they wonder, which could result in significantly different behavioral responses? They are certain there will be such pressures. (9)

But Finney and Jones are even more ecstatic about space as a force which will finally liberate us from the evolutionary cul de sac in which humanity has found itself since we destroyed our other hominid competitors many thousand years ago, and proceeded to populate (and now to over-populate) each nook and cranny of earth. Having done that, our biological evolution stopped, and evolution through cultural processes began. The voyage into space may unleash the biological potential again. They conclude:

"Homosapiens is not the final rung of a single evolutionary ladder going back 5 million years or more, but merely the 'only surviving branch of a once luxuriant bush'" which might be about to reflower. Thus, "what holds for earth [namely little chance of further 'natural' evolution on the part of homosapiens] may not hold for space. We maintain that the human race is actually on the threshold of greater bio-evolution.... Once we...spread far and wide enough, the forces of genetic change now blocked on Earth will be released once more."

This is a wonderful prospect indeed, I believe. But couple it with the emergence of Artificial Intelligence, on the one hand, and the "Biological Revolution" of test-tube babies and the like, on the other. Then it is clear that we may finally have discovered the "missing link."

It is us.

If it is not our destiny, it is at least our opportunity and responsibility to carry life away from the confines of this planet, our mother, into the expanses of space—if we will but seize the moment, and stop the mindless descent into a nuclear winter or an economic catastrophe, which is where our current policies are dragging us.

At one time I believed, because I wanted it to be so, that Carl Sagan and others are correct, and that the universe teems with "billions and billions" of life-forms, some sufficiently like our own that we can communicate with and learn from each other. I supported the Search for Extra-Terrestrial Intelligence entirely. I still do, but I am rather glad we have not--as far as I know--encountered any other life, much less intelligence, but our own.

If Extra-Terrestrial Life does not already exist, we can continue with the processes which will create it. If it already does exist, then we can enrich the pool of intelligence near Earth by creating some other than our own boring selves.

So I leave you with two envoys. One is an excerpt from a "Declaration of Independence" written by Jerome Glenn and George Robinson for Spacekind as it separates from Earthkind. The second, you will recognize, is of somewhat more hoary origin.

The "Declaration of Independence" begins as follows:

"Recognizing the distinction between thought processes occurring in space and those responding to the influences of inhabiting the Earth's surface;

"Believing that the habitation of space should be characterized by the full expression of the limitless varieties of human-related cultures;

"Believing that an accurate understanding of the biological foundations of value-forming processes in a space environment will contribute substantially to lessening the fruitless competition and violent conflicts among Earth civilizations;

"Desiring to elevate the evolution of homosapiens to its next logical stage;

"Be it therefore Declared:

"When in the course of human evolution it becomes necessary for progeny to dissolve the political and biological bonds which have connected them with their progenitors, and to assume among the powers of the solar system and galaxy the separate and equal station to which the Laws of Nature and their Creator entitle them, a decent respect to the opinions of Earthkind requires that they should declare the causes which impel them to their separation into Spacekind.

"We hold these truths to be self-evident, that Earthkind and Spacekind are created equal to their own respective environments, that once having been raised above their biological origins to a recognizable level of sentience and sapience they are endowed by their Creator with certain inalienable rights, and that among these rights are survival, freedom of thought and expression, and the evolution of individual and community knowledge."

After further enumeration of their reasons and justification for independence from Earthkind, the Declaration ends:

"We, therefore, the representatives of space migrants, space communities, and Spacekind descendants of Earthkind..., do, in the name and by the authority of Spacekind settled and living in space communities, solemnly publish and declare that their communities and their inhabitants are free and independent; that they are absolved from all allegiance to the governments and organizations of Earth; and that all political and ideological subservience of Spacekind to Earthkind is and ought to be totally dissolved.... And for the support of this Declaration, with a firm reliance on the protection offered through the Creative Intent, we mutually pledge to each other our lives, our fortunes, and our Sacred Honor." (10)

I hope that Earthkind--you and I--will have the courage now to divest ourselves of allegiance to the established forces of war, hate, greed, and narrowness which cloud our vision and lead us to a future of destruction and darkening fear. There is so much more ahead of us, if we will clear our eyes and take the chance.

Almost ten years ago, another anthropologist, Roger Wescott of Drew University, ended a talk on "Libration and Liberation: Thoughts on Living Beyond the Earth," (11) with this well-known exhortation by Tennyson. I can think of none better for us now:

> Come my friends,
> Tis not too late to seek a newer world.
> Push off, and sitting well in order, smite
> The sounding furrows; for my purpose holds
> To sail beyond the sunset, and the baths
> Of all the western stars, until I die.
> It may be that the gulfs will wash us down;
> It may be we shall touch the Happy Isles
> And see the great Achilles, whom we knew.
> Though much is taken, much abides; and though
> We are not now that strength which in old days
> Moved earth and heaven, that which we are, we are--
> One equal temper of heroic hearts,
> Made weak by time and fate, but strong in will
> To strive, to seek, to find, and not to yield.

Footnotes

1. Letter from Arthur C. Clarke to the British Interplanetary Society in *Spaceflight*, March 1985, p. 98.

2. S. B. Sells, "A Model for the Social System for the Multiman Extended Duration Space Ship," *Aerospace Medicine*, November 1966, pp. 15-23.

3. Cited in William MacDaniel, "The Future, Extraterrestrial Space Humanization, and Sociology," *Space Journal*, 1983, p. 13.

4. William MacDaniel, "A Scenario for Extraterrestrial Space Humanization," *Newsletter of the Space Settlement Studies Project*, Niagara University, Fall 1982.

5. Ellwyn Stoddard, "Social Life in Space Communities: Personal Liberation or Organizational Constraint?" *Space Journal*, 1983, *passim*.

6. B. J. Bluth, "Sociological Aspects of Permanent Manned Occupancy of Space," *Eleventh Intersociety Conference on Environmental Systems*, Spacecraft Operations Center Session, July 1981.

7. James E. Katz, "The Historical Antecedents in Colonization and its Application to Space Settlements," *Space Journal*, 1983, 20-28.

8. MacDaniel in footnote 3, at p. 12f.

9. Ben Finney and Eric Jones, *Interstellar Migration and the Human Experience*. University of California Press, 1985.

10. Jerome Glenn and George Robinson, *Space Trek: The Endless Migration*. Stackpole Books, 1978, pp. 202-207.

11. In *Anthro Tech: A Journal of Speculative Anthropology*. Spring 1977, p. 7.

Note: A lengthy bibliography on the social and political implications of space settlements is available from the author on request.

Summary of Chairman's Philosophy
for
the Working Group on "ISDN"

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1. Abstract

With computers penetrating society, telecommunications networks are undergoing a major change towards ISDN. Roles that telecommunications users must play in the transition are greater than ever. Standardization of such networks, the most important element in constituting ISDN, is discussed from users' viewpoint.

2. ISDN

2.1 Introduction

The recent and rapid technological evolution centering on micro-electronics has made a great impact on all sectors of industry, and has seriously affected products ranging from producers' goods to general consumers' goods. In addition to this development, we must turn our keen eyes to the impact of such sectors as manufacturing, financing, distributing and services on society and industrial structure. We find significant growth of personal computers being a major force that supports those impacts.

2.2 Computerization in society

Both the volume and sales of personal computers have largely exceeded those of the mainframes, owing to the rising tide of automation in offices (OA), as well as in factories (FA). The volume of equipment now causes the host of computer groups to shift their form of use from the conventional mainframe-centered pattern to a distributed-processing pattern, a change that has increased use of personal computers for ad hoc local processing. Such expanded use in the different forms leads to producing new networking requirements that inter-connect various types of computers, and at the same time, it urges users to look for realization of a more effective network linking host and local computers. Furthermore, increase in computer-minded population and in the expanding computer applications are diversifying the processing of information from data into voice, image and data patterns.

2.3 ISDN and Standardization

In the midst of this changing society, there still exists a large number of restrictions in terms of technology and achieving effective investment results. This is because the current telecommunications network was built over a long period of time on the basis of handling voice communication, which resulted in providing individual network for data and telex that are substantially different from voice or analog networks.

Today, we have ITU and CCITT working hard on key points required for setting up new ISDN standards in order to eliminate those restrictions and to create new network. The standardization of ISDN aims at closing the gap prevailing between conventional individual networks which were designed to provide individual services, as well as removing discrepancies existing between dedicated networks. These improvements lead to integrating current networks into a single network or to re-do network configurations.

2.4 ISDN impact on users

The standardization of telecommunications during the times when they were based on voice were extremely important requirements only for carriers providing network services and for manufacturers supplying equipment. However, the standardization efforts of telecommunciations today that challenge computer penetration into society is not confined to use only by telecommunications providers, but it also causes more users to be directly involved in the approach.

In view of these points, it has become a matter of great concern to the users immediately interested in the ISDN stream as to how developments can be made and how ISDN standardization could be fit into the swelling assets (information and equipment) built by the users themselves. In other workds, the point is how can society make the best of ISDN on the premise that means of conveying information and media are to be integrated and rebuilt into a new newtork.

2.5 Discussion point

Affected by liberalization of public telecommunications business in the U.S.A., U.K. and Japan, users' trend is an increasingly important and decisive factor in determining the direction of telecommunications services for the future. In these countries, some users associations participate directly in the work of standardizating ISDN.

In view of this context, I would appreciate your discussion in this Session, as one of the users, as to what you expect and the role you should play in preparing for standardization of ISDN.

TELECOMMUNICATIONS FOREIGN INVESTMENT IN THE DEVELOPING COUNTRIES: BUILDING THE NEW FRAMEWORK

by

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HISTORICAL BACKGROUND

In the early sixties the vigorous emergence of the so called multi-national organizations philosophy coupled with the nascent technology of satellite communications significantly impacted the policy making of the developing countries telecommunications ministries and a new wave of nationalism replaced the then prevailing standards of foreign investment and ownership of the Telecommunication Administrations. By the early 70's (for example, after ITT was nationalized in Chile), the nationalist push had gained additional momentum also enhanced by the vast petrodollars availability and by the credit expansion of telecommunication equipment suppliers and international financing agencies.

By 1982, the circle had gone its full length: the developing countries realized they could not grow at the rate of the 70's. Moreover, existing supplier or agency credits were reduced to the point of representing a most serious bottleneck to telecommunications expansion. Enthusiastic nationalists had proclaimed with vigor that foreign investment would compromise national security, could fail to meet social needs and surely would place countries under the control of ruthless profit makers. Meanwhile, the community of international credit agencies, philosophically leaning toward national telecom sovereignity, was making available resources that in some countries strengthened and improved dramatically the telecommunication infrastructure, i.e. Indonesia 1975-80, Egypt 1976-80. In other countries, this funding availability resulted in the continuance of traditional equipment suppliers dominance over the telecommunication administrations' old technology and vast administrative inefficiency, i.e., Ecuador, Sri Lanka.

Other countries, like Saudi Arabia and Kuwait, used their oil resources to attain a quantum leap into telecom expansion, thus avoiding the crisis that today, in the mid 80's, plagues telecom expansion in the developing world. For the oil rich countries, foreign investment or credit oriented telecom expansion was not an issue.

PRESENT SITUATION

It is not the intent of this writing to pass judgement on whether looking back at the 60's it would have been better to encourage development through foreign investment in lieu of credit, but rather to propose solutions that might place foreign investment as a balanced approach to reach telecom development.

On one hand, the mechanisms to encourage it and to achieve it are still available: OPIC 1/; IFC 2/; a new OPIC-type agency at the World Bank called Multilateral Investment Guarantee Agency (MIGA) in process of being organized; and a proposed agency at the Inter-American Development Bank, the Corporacion Financiera para America Latina (COFIAL), presently under consideration.

On the other hand, telecom opportunities in the developed world have changed dramatically after the ATT divestiture. Today, and for years to come, added to the commercial and financial forces of suppliers and bankers evolves the fresh technological and financial impact of seven telephone operating companies (BOC's) 3/, coming into the international arena with no interest whatsoever in being locked to technologies or suppliers, but committed to service improvement and quality control within reasonable price structures and fair returns.

To complement this seemingly favorable financing framework, the government of the developing countries have little political justification in prioritizing telecommunications projects for external credit allocations for the simple fact that food and other basic necessities come first in the list of scarce resources, and that telecommunications are perceived as requiring endless foreign exchange subject to heavy depreciation due to rapid technological innovation.

In this context, for example, India estimates a need of US$12.0 billion to get demand satisfaction by the early 90's, but will be satisfying only one third of its needs by decision of the planners. Likewise, Chile cannot afford even short term project financing for US$100 million since the country credit burden has gone beyond the limits of reasonable national debt repayment forecast, as judged by the bankers.

THE NEW FRAMEWORK

Telecommunications and information policies are undergoing significant changes in both facilitated and developing countries. One world-wide trend, presently in various stages of implementation, is the privatization of telecommunications and information services. Since telecommunications are increasingly perceived as indispensable to economic growth and national, social and cultural progress, means are sought to increase the reach, efficiency and effectiveness of such services nationwide and internationally. Basic to achieving these goals, is the transformation of the traditional civil services bureaucracies, encrusted with inefficiencies, labor problems and inertia, into management-run, efficient, flexible and modern enterprises which can respond to users pressures and can attract local and foreign private capital.

Privatization, therefore, is the term used for the transition from complete public ownership of telecommunications organizations to either private investors or to a combination of private and public sector investors. The latter is referred to as "partial privatization" and is probably the politically attainable first step for the transition process in most developing countries. Implicit in the above is the realization that only private capital can provide the impulse, motivation and magnitude necessary to the desired change, public capital for telecom being virtually unavailable in most developing countries. Several governments (for instance Malaysia, Chile, U.K., Netherlands, Italy) have made privatization a major goal and advocated the sale of government enterprises to cut government spending, to ease the drain on public resources and to streamline the bureaucracy.

Privatization, partial at least, of the telecommunications sector in developing countries is important and essential for a balanced approach to development. Firstly, no national public sector has been able to develop a progressive, technologically modern, efficient and effective telecommunications services provider. Secondly, no national public sector has been able or willing to invest the large capital required to meet real and latent demand. Thirdly, governments are coming to the realization that telecommunications are a must for progress and that privatization brings about the double advantage of achieving service expansion as well as cutting down on public expenditures in telecommunications. Therefore it is realistic, desirable, in fact virtually unavoidable to drive towards privatization. Politically however, full privatization may be untimely in many developing countries, where statism, central planning and central control are their essential characteristics. Partial privatization, that is mixed-ownership by private and government interests, is a workable compromise that allows sovereign control of telecommunications by the state and that, at the same time, streamlines the operation and increases service efficiency.

The developing countries telecommunications administrations are coming back by reason or by necessity to consider that foreign investment, after all, might be the prudent and perhaps only feasable way out to meet future telecom demand.

However, on the periphery of experienced telecommunication administrations' national executives who might have reached the conclusion that foreign investment must be attracted, looms as a sword of Damocles the uncertain reaction of the government economic planners, the interest of the traditional suppliers and the somewhat unpredictable internal political forces that from right to left have never quite had a romance with foreign ownership, even if partial.

All this needs to be sorted out and the road might be full of hurdles. However, the internal consolidation of all efforts needs to be tackled in the framework of balanced approaches where no trigger-happy profit makers on the outside and dreamers on the inside conceive investment schemes that are potential political and financial time bombs.

The game needs other key players among which the international bankers, the internaional financial agencies and established private telephone companies should be included. The latter, besides being able to contribute with captial assets in cash, will provide the sorely needed operating, management and technological modernization of the Administrations, to improve their efficiency and cost-effectiveness.

A good investment program should be developed taking into account the past involvement by the World Bank and the Regional Banks in the telecom infrastructure building of the 60's and 70's. In spite of their commendable impact, the Administrations remain generally overstaffed and institutionally weak. Also, the transfer of technology, "the UN banner of the 70's", never came to a reality, for a combination of suppliers lack of vision or interest, of the Administration lack of in-depth interest and of well known brain-drain and, perhaps above all, of the too rapid technological advances. When local manufacture has come into play, though it might reflect a reasonable degree of foreign investment, it has had limited success for being locked to a single technology, and for being limited to the mere provision of equipment without regard to improving telecom operation and financial management.

Broader investment patterns with healthy international public support and guarantees and with an adequate participation of the non-supplier telecom community of operators and consultants, might be the balanced framework for the future. In this context, the newly created Center for Telecom Development 4/ might be a good catalyst for coming closer to the right solution.

The influx of foreign public (credit agencies) and private (investment banks and telephone companies sinergistic participation) investments in the telecommunication sector of developing countries will result in the following benefits:

1. Attain significant progress toward satisfying the huge latent demand.

2. Provide the sorely needed telecommunications infrastructure so necessary to achieve economic growth and social and educational progress.

3. Achieve at least partial privatization of the telecommunications operating administrations with concomitant moderization, increased efficiency and cost savings otherwise unattainable.

4. Join the more facilitated countries in interchanges, commerce and education.

The real key however, is held by the planners of the developing countries, where it should be understood that the developing world must not become increasingly isolated by a decade of scarcity of foreign exchange from the mainstream of telecommunications service, improvement and technology.

1/ Overseas Private Investment Corporation, an agency of the U.S. Government.

2/ International Finance Corporation, an associated private sector oriented agency of the World Bank.

3/ Bell Operating Telephone Companies: Pacific Telesis, Bell Atlantic, Nynex, Ameritech, Bell South, U.S. West, and South West Bell.

4/ Center for Telecommunications Development, an international organization under the auspices of the International Telecommunication Union (ITU).

INTERNATIONAL COOPERATION IN HUMAN RESOURCES MANAGEMENT

RICHARD E. BUTLER
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International Telecommunication Union
Geneva

1. Abstract

The paper provides an overview of the increased importance of human resources management in the planning, installation and efficient operation of telecommunications. The paper also describes the actions taken within the ITU following the receipt of the Report of the Independent Commission for World-Wide Telecommunications Development and the establishment, within the framework of the ITU, of a Centre for Telecommunications Development.

2. DEVELOPMENT OF TELECOMMUNICATIONS

In 1945 there were 41 million telephones in the world. The total today is 668 million - an increase of 1500 % or 7 % per year over 40 consecutive years. As new services develop - telefax, data transmission, teleconferencing and others - there are no signs yet of a slowing down of this growth.

With the emergence of personal computing facilities within reach of nearly every household in the industrialized countries, and the ever growing number of connections between data processing and communication facilities, we are witnessing the birth of an "Information Society".

At an earlier occasion here in Honolulu at the start of World Communications Year, in 1983, I have commented extensively on the development of communications but also on the anomalies in the world telecommunications development. You are certainly familiar with the statistics demonstrating the imbalance in the distribution of telecommunication facilities in the world: three quarters of the world's telephones are located in eight countries only; and the developing countries with 70 % of the world's population are using only 7 % of the telephones.

At the same time, I announced the creation by the ITU Plenipotentiary Conference of an Independent Commission for World-Wide Telecommunications Development. This Commission has met extensively during World Communications Year and in 1984 and presented its report **"The Missing Link"** in January 1985. In its report, the Commission analyzes the present situation of telecommunications, projects objectives for the next twenty years and makes a number of concrete recommendations. As a major objective, the Commission states that

> "by the early part of the next century virtually the whole of mankind should be brought within easy reach of a telephone and, in due course, the other services telecommunications can provide."

It is my belief that the recommendations contained in the report will make an important contribution to reaching this objective.

3. A NEW CHALLENGE TO TELECOMMUNICATION ADMINISTRATIONS

New technologies are bringing down the cost per installed line in a spectacular way. New services are being offered, and the over-all quality is improving spectacularly with the growing use of satellite transmission, the digital coding of signals and the use of optical fibers. The link between data processing facilities and telecommunications is creating a vast new field of applications.

Yet this tremendous development also represents a vast challenge for the management of telecommunications. The proper planning of future networks integrating these new services and making the best use of available technology requires new skills for which we may have had little preparation. Traffic engineering has become a vast and complex field of knowledge of a highly specialized nature, and yet the problems we are facing cannot be solved by specialists alone.

The staff engaged in telecommunications has been growing in parallel with the extension of the network. A vast effort has been made throughout the years to recruit, to train and to maintain the workforce necessary to install, maintain and operate the telecommunication system.

This function is also becoming more and more complex. New technologies are bringing new models of work distribution, as many functions are being taken over by automatic systems. A close look on the routine maintenance tasks may reveal that they are in fact becoming simpler while the equipment is becoming more and more complex.

This new human problem is only a recent addition to the range of personnel problems with which telecommunication administrations are faced.

Getting the right man for the right job proves to be exceedingly difficult - and he or she may not stay very long, as his skills have a high value on the labour market.

These problems exist in all countries, and yet they are particularly acute in developing countries.

4. SPECIAL PROBLEMS IN DEVELOPING COUNTRIES

Many interacting factors concur in impeding the development of telecommunications in developing countries. The report **"The Missing Link"** provides an excellent summary of these factors, which include the relative priority accorded to telecommunications and the fact that often insufficient recognition is given to the significance and potential of telecommunications in the national infrastructure and its impact on all other sectors. Other limiting factors are economic constraints, scarcity of hard currency, lack of trained staff, and geographical factors particularly in remote areas.

Regarding the human resources, developing countries often find themselves at a disadvantage again. Although immense efforts have been made in many countries for developing the national education system, often it is difficult to recruit staff with the necessary educational background, especially at the all-important technical level. Then, the specialized nature of the skills required in telecommunications require that some staff are trained within the administrations. In many cases, a wide variety of equipment is in use and staff need to be trained on many different systems. Once trained, adequate incentives must be offered to retain this highly-skilled staff.

Another factor should be mentioned. At the highest level, development of professionals including scientists and engineers takes place at universities and research institutes. Here the education function is combined with research and development into a powerful mechanism for teaching and learning at the forefront of technology. These facilities however are concentrated in the industrialized countries and only the larger developing countries can achieve similar training and education at the very highest level.

5.DEVELOPMENT OF HUMAN RESOURCES: NEW PERSPECTIVES

The tendency exists to use the words "Training" and "Human Resources Development" as if they were synonyms. But the establishment of a **Human Resources Policy** has far-reaching consequences which need to be carefully assessed. When we speak of Human Resources Management (HRM) we view ourselves and every other member of our organization as a resource made available to the organization under certain conditions. We may speak therefore of training as an investment made in human resources, and we may expect a fair return on such an investment. Obviously, we must acknowledge that human resources are not owned by the organization, and that they may react in a less predictable way than other resources. But how many training centres do actually conceive of their role in such a manner ? What efforts are made to measure the return on investment rather than simply the throughput figures in terms of trainee-weeks and annual budgets ?

Human Resources Management includes at least the following areas, some of which are entirely outside the direct training function but nevertheless have a major impact on the results of the organization. Telecommunication administrations may wish to review their mode of performance in these areas to determine how effective they are in their use of available human resources.

PERSONNEL INFORMATION SYSTEM
MANPOWER PLANNING
SELECTION AND STAFFING
TRAINING AND DEVELOPMENT
ORGANIZATION DEVELOPMENT

It is often found that the training of management staff cannot be effective as an isolated exercise. Organization development is a method to assist managers in assuring healthy inter - and intra-unit relationships and to initiate and manage change. It may well be argued that the management of purposeful change is the most challenging task with which all of us are faced.

JOB DESIGN
DIRECTION
PERFORMANCE MEASUREMENT AND FEEDBACK
MANAGEMENT OF CONSEQUENCES of good and weak performance
Individual and group **PROBLEM SOLVING**
SELF-MANAGEMENT by managers and employees

A careful review of these areas may reveal opportunities for making a better use of the human resources available.

6. HUMAN COMPETENCY DEVELOPMENT: COSTS AND BENEFITS

Too often in the past, we have heard telecommunication managers complaining that they had a "training problem". When questioned further, it usually appeared that training had been ineffective, that training was too expensive or just could not be obtained.

If we wish to develop our human resources in parallel with our telecommunication services, it is essential that we view training not as a problem but as a solution which has its specific place among other solutions such as those I have mentioned earlier. Training is an investment in human resources, and it can be a very profitable one. Like any investment, it needs to be carefully planned and monitored and the returns should be objectively evaluated.

The systematic development of human competencies can take on many different forms, and the most effective method should be carefully selected for each particular case. Methods may include formal training in the organization's own training centre, on-the-job-training, training overseas in another administration or with a manufacturer, and we should not neglect self learning either. In every case, effective training requires the setting of precise, job-relevant objectives, careful planning and a measurement of the results on the job. In all these areas, the ITU has developed guidelines and standards which help training organizations and their clients to make the best possible use of available training resources.

At the last Interregional Coordination Meeting of the ITU Sharing System in Montpellier, France (1984), the costs and the benefits of training have been extensively examined. At this meeting, precise recommendations were adopted regarding the measurement of training costs. The benefits of training were also identified and classified in six different categories, covering aspects of:

- Job performance
- Efficiency
- Job satisfaction
- Safety
- Public image of the organization
- Over-all performance

It was realized that it is extremely difficult to establish the precise cause-effect relationship between training and these results because so many factors other than training affect the operational outcomes. Nevertheless, by systematically monitoring the indicators related to these different categories, both the qualitative and quantitative benefits of training can be demonstrated.

7. THE NEED FOR INTERNATIONAL COOPERATION

As you are aware, the world's telecommunications cannot operate without extensive international cooperation. The ITU is spending 25 to 30 million Swiss francs yearly to ensure that the necessary international standards are available for the design, interfacing and operation of telecommunication systems in its Consultative Committees. Further provisions are made for regulatory negotiations in Administrative Conferences. Inevitably, the planning and coordination of systems or information necessary to operate systems and services is also increasing. As far back as 1965, the ITU Plenipotentiary Conference (Montreux) decided there was a need for the systematic development of human resources to satisfy the operational needs of telecommunication administrations. The appropriate Resolution stated:

> "... it is desirable to apply the same or equivalent technical standards, both for operation and maintenance;
>
> b) that this can be achieved only if comparable technical talent is available in the countries concerned;"

Consequently, a modest portion of ITU's financial resources have been utilised for stimulating the use of international training standards. The creation of the Training Division was followed by the initiation of the CODEVTEL Project which has now resulted in an International Sharing System for Training. It is noteworthy that (unlike the development of technical standards and manuals by the International Consultative Committees) the vast majority of activities is taking place in the participating countries through cooperation between national staff and ITU's Regional Training Development Experts.

Clearly, strong international cooperation in the area of telecommunication training is an inescapable must. It can take various aspects:

- Sharing of training materials, as under the ITU Sharing System for Training; the spectacular growth of this system may be illustrated by the more than 400 training packages presently available for sharing and the 350 requests for such packages received in 1985;

- Sharing of competent instrurtors - a traditional activity in ITU Technical Cooperation training projects, but increasingly also as a form of technical cooperation between developing countries;

- Overseas training as carried out under various programmes including ITU's provision of fellowships; the publication of the Catalogue of Training Opportunities is intended to facilitate and improve this form of international cooperation;

- international seminars on latest technologies, as a preparation for international conferences and as a way to exchange experiences between different countries.

All such forms of international cooperation should tend toward the same goal: to provide every telecommunication employee with the right skills at the right time, at the minimum over-all cost.

8. NEW TRENDS IN TRAINING PROJECTS

I have indicated earlier the need to widen the scope of traditional training activities. This trend is already now visible in new telecommunication training projects carried out with the assistance of the ITU. Whenever the financial constraints allow it, an expert in modern training development methods is included in the project team. Project results are evaluated not only on the basis of trainee throughput and examination results, but on the basis of the operational benefits to the entire organization. And finally, the need for management training and organization development is carefully evaluated and included as required in the project formulation and implementation.

9. FUTURE PERSPECTIVES

The Independent Commission for World-Wide Telecommunications Development recommended

> "that the major regional and sub-regional political and economic organizations consider as soon as possible how best Research and Development institutes might be established"

and also

> "that the Research and Development institutes ... be developed as a source of higher technological, supervisory and managerial training and as coordinating agencies for external training opportunities"

There is no doubt that such institutes could become extremely valuable centres for the development of human resources as well as centres for the transfer of technology; and the ITU is ready to contribute to their development as soon as an opportunity can be identified.

Telecommunications have a major role to play in the economic, social and human development of the world. The functions of telecommunications are not only supportive, but also proactive in the generation of economic growth. The development and rational management of human resources are necessary conditions of the implementation of effective telecommunications; at the same time, telecommunication administrations and manufacturers have a major responsibility for the development of human resources not only for their own needs, but also as a contribution to the social advancement of their respective countries. In a very true sense, what is good for telecommunications is good for the world.

10. LOOKING BACK ON THE YEAR 1985

I started out this statement by referring to the Report of the Independent Commission which I formally received from its Chairman, Sir Donald Maitland, on 22 January 1985. The Commission, as you know, issued a series of recommendations and set time bench marks for their realization. Let us look back at what we have done and achieved with respect to the report in the course of the last 12 months.

The Missing Link was reproduced in 19,000 copies in three languages. It was distributed world-wide, not only to telecommunication administrations and operating entities, but also to other government ministries, the industry, and a multitude of international, governmental and non-governmental organization, and to a wide cross-section of telecommunication users. In so doing we have launched the telecommunications debate at all levels on a very wide scale.

11. THE WORLD TELECOMMUNICATIONS DEVELOPMENT CONFERENCE

In May 1985 the First World Telecommunications Development Conference in Arusha, Tanzania was organized at ministerial level and conducted a thorough review of the Commission's findings and recommendations. The review resulted in the Arusha Declaration. This Declaration endorsed the main thrust of **The Missing Link** report and urged governments of industrialized and developing countries to take a series of steps to minimize, if not to close, the ever-increasing telecommunications gap between North and South. Of particular significance were the matching provisions. In urging developing countries to give higher priority to the sector, developed country institutions were also urged to match that objective by giving higher priority in their financial investment and assistance programmes.

Apart from the World Telecommunications Development Conference, we organized four information sessions (Geneva (twice), Washington and Singapore) and some national presentations especially for the benefit of the private industry sectors, operators and major users, to whom part of the report was addressed, i.e. in particular with regard to giving them an opportunity for partnership in the development process through the establishment and operation of a Centre for Telecommunications Development, within the framework of the Union.

12. THE CENTRE FOR TELECOMMUNICATIONS DEVELOPMENT

In July 1985 I formally reported on the consultations which the Independent Commission urged me to undertake as a matter of urgency for the start-up of the Centre in accordance with their target date of October 1985. The Administrative Council also reviewed and debated on the comments received on the report and, from Administrations, endorsed the major thrust of the findings and recommendations of the report, inter alia, decided by a specific Resolution to establish a Centre for Telecommunications Development within the framework of the ITU and to be governed by an Advisory Board. The Centre is to have its separate and identifiable budget, which is to be voluntarily funded from governmental and non-governmental sources.

The Advisory Board which was duly constituted by the Administrative Council was to consist of 21 Members including the Secretary-General who is the permanent Member (ex-officio) and serves as its Senior Vice-Chairman. Board Members are appointed initially for a period of two years, with a provision for subsequent rotation. The Board has specific responsibilities for overall policy and management within the framework established by the Administrative Council and the International Telecommunication Convention, as well as for the mobilization of adequate and stable resources for the operation of the Centre and the services to be provided by it.

The constitutional meeting of the Board was held in Geneva during the last week of November. The President and Chief Executive of Teleglobe Canada, Mr. J-C. Delorme, was elected Chairman and Mr. A.D. Ntagazwa, Deputy Minister of Communications and Works, Tanzania, was elected Vice-Chairman. The Board took this occasion to discuss major policy matters such as the mandate and the scope of the activities of the Centre, the rules and procedures of the Board, and resource mobilization. A firm decision was taken to initiate the recruitment of the Centre's Executive Director and his Deputy.

The Board also took the occasion of its meeting to hold an information meeting with resource providers and other interested parties to explain to them the objectives of the newly created Centre and to invite them to make voluntary contributions.

In summary, we can therefore say that the Commission's report has been circulated, an active debate on telecommunications development has been launched and the mobilization of resources is being actively pursued.

13. THE PROVISIONS OF RESOURCES FOR THE CENTRE

In this respect let me remind the international telecommunications community of the order of magnitude that the Commission identified as basically necessary for telecommunications development in developing countries to meet the target **" ... to bring all of mankind within easy reach of a telephone by the beginning of the next century"**. It has estimated that annual investment of US$ 12 billion would be necessary.

An investment of this king would surely require engineering and managerial consulting services of the order of US$ 1 billion, which would have to be mobilized and secured from national, bilateral, multinational and commercial sources. You can therefore appreciate the extent and volume of expertise that needs to be marshalled on an annual basis.

14. THE CENTRE AS A STIMULANT AND ACCELERATOR OF DEVELOPMENT

It is with respect to these orders of magnitude that the activities and resources foreseen by the Commission have to be weighed. There can be no question of the Centre taking over, or indeed competing with on-going consultancies and their resources. Thus, let me clearly reiterate that the purpose of the establishment of the Centre is not to be a substitute for the existing and on-going advisory services but rather as a stimulant and accelerator of activities in the field of telecommunication development. There is a lot of room and many possibilities for action for all concerned. In fact, we expect that the partnership through the Centre will be a trigger for concrete action with resulting increases in consultancies and demands for others as the telecommunication investment level rise.

I would therefore appeal to resource providers to bear in mind the ultimate objective of the mutually beneficial endeavour we are embarking upon when they examine their responses to the resource mobilization campaign.

The scale of contributions to the Centre should be commensurate with the volume of investment target that it is intended to trigger.

I have told the Board, which has an essential function, to mobilize resources, that the concept of the Centre and the composition of the Board's membership is a unique experiment in international cooperation. I have said that representatives of the private sector, industry and operating entities are taking part in the work of the Board on an equal footing with representatives of governments. Such a privileged participation naturally entails a special responsibility in the realization of the common objective.

The Advisory Board has started out its mission in the right spirit and I trust it will win the confidence of contributors and beneficiaries alike in laying the foundation of a mutually beneficial Centre for Telecommunications Development. I for one have full confidence in the experiment and am prepared to do everything in my authority to make it a sucess.

Human Resources Management
In a Changing Environment

Gerald F. Foley, Teleglobe Canada

1. ABSTRACT

This paper presents an overview of Teleglobe Canada's approach to management of its human resources during the process of changing from an analogue to a digital environment.

2. INTRODUCTION

"It is ironic that rapid changes in technology are threatening those most responsible for these changes - engineers, scientists, technicians and their managers - with obsolescence of their knowledge and skills."

In the field of telecommunications the introduction of digital switching systems is having serious impact on the operating staff, both in terms of the need to significantly reduce the numbers employed and to retrain those remaining.

Teleglobe Canada, an international telecommunication company, is now in the process of completion of a six year program involving its switching systems at its three major telephone switching gateways of Montreal, Toronto and Vancouver, and this paper is intended to share our experiences in the following areas.

2.1 **Downsizing**
Digital switching requires far less effort in terms of maintenance, repair, programming changes and installation activity than crossbar systems with the consequence that a significant staff downsizing program had to be well thought out, planned and implemented far in advance of the Ready-for-Service date of the digital system.

2.2 **Training (Internal)**
A significant amount of retraining was required for staff who had been engaged during the analogue era. The thrust of this presentation will be in the area of retraining of the human resources.

2.3 **Training (External)**
This paper also briefly addresses Teleglobe Canada's involvement in the Commonwealth Telecommunications Organization Training Assistance Programs for Developing Nations.

3. THE TECHNOLOGY

The major changes in the technology are

- large-scale integration - primarily computer based
- inherent high reliability
- no routine maintenance required. Largely self-diagnostic.
- requires highly specialized maintenance support.
- computerized analysis required for fault isolation and repair.
- increasing move to "throw away" units.

For Teleglobe, it was necessary to revise our complete operating philosophy, as follows:-

3.1 Traffic

3.1.1 Circuit maintenance concept together with automated test devices.

3.1.2 Integration of various test centres (eg. telephone, telex, telegraph, private services).

3.1.3 Automated production of real time data to permit real time analysis of traffic conditions.

3.2 Equipment

3.2.1 No preventive maintenance except for conventional or electromechanical devices.

3.2.2 Need for maintenance, installation and operating staff considerably reduced (approximately 30%) and those remaining to be retrained to cope with computer-based digital technology.

3.2.3 Equipments segregated into a "clean room" environment (no people) with external monitor and control.

3.2.4 External primarily software, support to be available on demand.

4. Teleglobe Experience in the Management of its Human Resources in a Changing Environment

4.1 TRAINING REQUIRED TO MAINTAIN & REPAIR EACH SYSTEM

Whenever the question of training and staffing requirements arise, as it does with each proposed new system, it is apparent that it cannot be answered in isolation, since it is embodied in the larger question of; what are the Operational Maintenance Requirements (O.M.R.)for each system?

This question of O.M.R. is fundamental and should be initially addressed, at the concept definition stage of each project. To this end, Teleglobe has developed a basic Maintenance & Repair Strategy (M.R.S.). A concise description of this M.R.S. follows, with the intent of showing the interdependance of level of repair and level of training required and hence, the staffing requirements.

4.1.1 MAINTENANCE AND REPAIR STRATEGY

Objective

The longterm objective is that all systems should be self-monitoring and equipped with self-diagnostics thereby minimizing outages, labour costs and redundancy requirements, while in the near term maintaining our current and intermediate systems.

TRI-LEVEL MAINTENANCE PHILOSOPHY

4.1.2 Introduction

Whenever a system has to be maintained at a high level of availability, the questions of "how, degree and costs" must be addressed. In order to address these questions in a regulated manner, Teleglobe defined maintenance in terms of its sub-components. These sub-components are expressed by Teleglobe's tri-level maintenance philosophy.

These distinct levels of maintenance are -

- First Level - "On Line"
- Second Level - "Off Line"
- Third Level - "Catastrophic"

EXAMINATION OF TRI-LEVEL MAINTENANCE

4.1.3 First Level On-Line

Stations must be provided with training for their staff to enable them to carry out the on-line maintenance of systems without major interruptions. This includes in varying degrees, preventive, corrective and controlled maintenance.

4.1.4 Second Level Off-Line

This is the area that requires further investigation, as this is the real area where the level of repair by Teleglobe is determined. There are three options which can be addressed:

4.1.4.1
100% by the manufacturer(lowest level of repair, training and staffing required by Teleglobe)

4.1.4.2
100% by Teleglobe (highest level of repair, training and staffing required by Teleglobe)

4.1.4.3
a compromise of some PCBs by Teleglobe and the rest by the manufacturers.

4.1.5 Third Level Catastrophic

Involving loss of a system where the assistance of an off station agency such as Head Office (Operations or Engineering), the manufacturer or another station, may be required to take control of fault repair. This is an area where the station cannot be expected to stand alone.

4.2 STAFFING REQUIREMENT PROJECTIONS

Having defined one's repair strategy, it is possible to quantify the staffing needs. If there is growth in any area which is in a technological transition phase, then normally, the new expertise requirement may be attained, at least in part, by hiring. This may also be the case if the manpower requirement is relatively constant and natural attrition gives a short fall in available staff. This short fall could make hiring a viable option. However, the case of a decreasing manpower requirement, which is running ahead of the natural attrition, is the position in which you are most likely to find yourself.

Our experience is that the transition from analogue to digital results in a significant staff surplus and a program to meet this excess surplus of staff must be developed which takes into account the particular human resource culture, union collective agreements, and external factors of the company involved.

During 1977 Teleglobe carried out three major reviews within its Operations Department. These covered departmental organization; technological change and a reassessment of its human resources.

4.3 Existing Staff (Technical Profile)

A technical profile of the staff can be obtained by referring back to the Personnel Department for a search of its records. While this gives a fairly detailed picture of the staff, it may not give you a feel for each individual's attitude towards change, but it is a good management tool for gauging the overall ability of its staff.

A more detailed staff profile can be obtained, by each manager, if each staff member produces an up-to-date resumé which includes their strength and weakness, as they see it. It is most important that each member of the group be given a personal interview by his immediate superior or manager. It is at this point that a profile of the "whole" person can be obtained. He can express his aspirations, doubts and fears about the impending changes.
Decisions on the employee's ability to challenge and the duration or pace at which training will take place, can then be fully addressed.

4.4 TYPES OF TRAINING AVAILABLE

Initially it was Teleglobe's practice to acquire a comprehensive training package as part of every major project. (The training from the manufacturers had its positive and negative aspects.) Excellent for practical but low in theory.

A review of these courses and the response of the staff was under-taken with the result that it was concluded that there was a need for better preparation in digital technology basics, before taking the manufacturers' courses.

The level required was ascertained from reviewing the prerequisites required for equipment and computer courses given by major manufacturers.

The minimum basic requirement for staff assigned to maintain digital equipment (before progressing on to equipment courses) should include the following topics:-
- Boolean Algebra, Logic Gates
- Logic Implementation
- Sequential Logic, Flip-Flops, Counters.
- Semi-conductor Memories
- 1-Bit Microprocessor
- Industrial Control Unit
- 8-Bit Microprocessor (itel 8080, Motorola 6800)
- Software and microcomputers

The course objective should enable the participants to:

- Design and implement logic circuits using standard integrated circuit (I.C.) chips to solve basic level application problems.

- Evaluate arithmetic - logic - unit (ALU) and random access - memory (R.A.M.) chips by breadboarding these on a digital logic trainer.

- Interconnect a small microprocessor to input, output, interface control logic to produce an industrial control unit.

- Write software for an eight-bit processor and interface with a read-time device, e.g., - a numerically controlled (N.C.) machine.

4.5 TRAINING PROGRAM

At this stage a practical training program can now be developed. A typical example included is the Toronto Gateway Program which was developed using a local college of technology and an Ontario retraining grant.

The training needs profile of the staff showed that ten (10) required the prerequisite training,then these ten plus plus fifteen (15) more required 6800 Microprocessor training. This would enable the staff to go through the various manufacturers courses.
The manufacturer's course (digital switch) was initially given to 2 Supervisors and 6 communications technicians. An inhouse course will be given to the remaining staff.

5. TELEGLOBE ASSISTANCE TO DEVELOPING NATIONS

5.1 Training Assistance to Developing Nations

Teleglobe, as a member of the Commonwealth Telecommunications Organization, embarked on a program of collaborative activities in the form of training (technical & administrative), information exchange and other activities.

The nature and objective of the program is such that it is designed to promote the efficient exploitation of the Commonwealth external telecommunications network and services by providing Partners with training, expertise, and other mutual assistance in the management and operation of an international telecommunications undertaking. With the exception of a contribution by the Commonwealth Fund for Technical Cooperation (CFTC) the program is funded solely by members of the Commonwealth Telecommunications Organisation who are also expected to make available resources for accomplishing the two basic types of collaborative activities which make up the program -

5.1.1 **Multilateral (Partnership-wide)** or centrally administered training and other collaborative activities,such as teach-ins, seminars, and courses coming under approved program;

5.1.2 **Bilateral** or centrally administered training and other collaborative activities undertaken by individual Partners and coming under an approved program.

5.2 Operation of the Program

Planning for each year's program begins on April 1st, one year before the start of the actual program, when Partners are invited to submit formal requests for mutual assistance. These requests are sent to all Partners so **that they may offer assistance if they** so wish. On the basis of responses it receives the Consultative Committee on Collaborative Arrangements (CCCA) **then develops a proposed annual** program of collaborative activities which it submits to the Council's Board of Management for approval. Once approved the program is implemented and coordinated by the CCCA with the Bureau (the Secretariat if the organization) providing the necessary administrative and logistic support.

5.3 Program Guidelines

Guidelines have been established to

assist Partners in identifying their needs and the CCA and the Board of Management (BOM) in selecting projects for inclusion in the program. These guidelines have been designed to ensure that the objective of the program is met and also that an equitable distribution of assistance is maintained.

5.4 Criteria for Project Selection

In selecting projects for inclusion in the annual program, the CCCA gives preference to those which contribute most effectively to the objective of the program and, accordingly, favourable consideration is given to projects:

5.4.1 Which are cost effective and whose size is proportionate to the size of the program.

5.4.2 Where benefits accrue not only to the recipient but also to the Partnership as a whole;

5.4.3 Which fulfill a particularly urgent need;

5.4.4 Where the lack of funds and other resources are critical to meeting the need;

5.4.5 Which are properly scheduled to coincide with the Partner's operational requirements;

5.4.6 Which can be carried out collectively among several Partners on a sub-regional basis;

5.4.7 Which contain a multiplier effect whereby the assistance provided is self-perpetuating within one or a group of Partners (e.g., training for trainers courses);

5.4.8 Where a larger number of staff can be trained at one time (and preferably in their home country.)

5.4.9 Which result from requirements that are adequately and precisely defined;

4.4.10 Which avoid duplication of effort and the resultant misallocation of scarce funds;

5.4.11 Where developing Partners are able to provide assistance.

To the extent practicable and cost effective, services are obtained from Partners themselves or nations of Commonwealth countries before resorting to non-Commonwealth sources.

In accordance with the objective of the program, international telecommunications projects are given preference over domestic telecommunications projects. However, where a requesting Partner can demonstrate that a domestic project would have significant beneficial impact on the standard of international service, the CCCA will consider each such proposal on its own merits and make a recommendation to the BOM accordingly.

In selecting projects the CCCA takes into account the order of priority stated by the requesting Partner.

5.5 Sovereignty of Choice

One very important principle of the program is sovereignty of choice whereby Partners requesting assistance are free to state their preference should more than one offer be made; however, when a Partner does not select the least expensive of comparable offers, CCCA may recommend that it pay a share of the assistance received which may be higher than the amount it may have been asked to contribute had it chosen the lowest cost offer.

Teleglobe has been involved with the CCCA program from the outset and included is a list of countries who have received assistance from Teleglobe for the periods

1983/84

Countries	Department
GAMBIA	Finance
GHANA	Operations
NIGERIA	"
UGANDA	Finance

1984/85

Countries	Department
FIJI	Finance
INDIA	Engineering
KENYA	"
NIGERIA	Operations/Finance
SRI LANKA	Operations
SWAZILAND	"
TANZANIA	Finance
UGANDA	Operations
ZAMBIA	Operations/Finance

1985/86

Countries	Department
GHANA	Operations
GUYANA	Marketing
MALAYSIA	Operations/Mgmt. Information Services
SRI LANKA	Operations
SWAZILAND	Operations/Finance
TANZANIA	International Affairs
TRINIDAD &TOBAGO	Engineering

As for the next program coming up in 1986/87, this is presently being reviewed.

Given the excellent response received from the countries trained in the past two years and the success of training taking place presently under the 85/86 program, Teleglobe believes that the programs are filling their intended objectives.

6. PROPOSED GUIDELINES FOR STAFFING NEW SYSTEM

As a result of our six year program review, we have developed guidelines for staffing new systems. These are set out in the following steps:

- Objective
- Training Methods
- Organising and implementing
- Evaluation
- Personnel, training aids and facilities

6.1 Objective

The objective is to provide the staff with sufficient knowledge and expertise relevant to the effective and efficient performance of their tasks.

6.2 Training Methods

Training has three fundamental modes as follows:

6.3 Formal Training Courses

Training requirements may be satisfied through participation in suitable academic and system orientated courses for technical staff and digital overview courses for management staff.

6.4 On the Job Training

The trainee learns in real situations. Another positive aspect is that the trainee is productive whilst undergoing training.

6.5 Self-Study and Development

Self-study and development is an ongoing process of acquiring relevant knowledge in order to keep abreast with new developments and techniques.

6.6 Organizing and Implementing

When and How to introduce training programs on digital systems technology should be defined in the planning process by referencing to the Operational & Maintenance Requirements (OMR).

6.7 Evaluation

Teleglobe's view is that after having identified, organized and implemented training programs, it is essential to validate their effectiveness, by the use of real time and end of course feedback mechanisms.

6.8 Personnel, Training Aids and Facilities

We found that the success of any training program depends on the availability of:

- Skilled staff adequately trained in teaching techniques and relevant subjects.

- Adequate training aids and facilities.

7. CONCLUSION

Whenever technological changes occur, the events which come to the fore are retraining, redeployment **and redundancy.** Of these three, redundancies is the most sensitive issue and it should be addressed in a direct and humane fashion on a priority basis.

Where possible, a program for early retirement should be established. It should be flexible enough to adjust to the individual's position within the company and prospective position outside the company. It should also take into account the position of the much younger redundant employees with perhaps partial assistance via employment agencies in finding alternative employment.

When a comprehensive program such as this is embarked upon, it not only helps the employees leaving but also those staying. This, in turn, is good for the company.

The question of **redeployment** and **retraining** can be handled by proper planning and carried out in a straightforward manner by establishing:

- level of repair
- level of training
- level of knowledge of staff

and from these, develop a training program which includes formal courses, self-study courses and on-the-job training. These courses should have direct and indirect feedback mechanism which will assist in the evaluation of their effectiveness.

NEC International Training
NEC Corporation

Sasaharu Arakawa
NEC Corporation
Tokyo, Japan

1. Abstract

The paper is a comprehensive explanation on NEC international training. What is NEC international training? Why is it so important for the C & C company? Where and how is it operated? How rapidly is it expanding? How is it featured? With various illustrative slide-films, the paper tries to give a full picture of NEC international education and training activities in the fields of telecommunications, computers and industrial electronics.

2. INTRODUCTION

This is to try to introduce to you a comprehensive picture of NEC international training.

3. SUBJECTS

My presentation covers 6 (six) subjects, namely:

1. NEC - Corporate Profile
2. International Training Activities
3. Training Organizations and Facilities
4. Training Courses
5. Features of NEC International Training
6. Efforts for Future Improvements

3.1 SUBJECT 1
NEC CORPORATE PROFILE

For better understanding of NEC international training, I would like to briefly explain about NEC.

3.1.1 NEC AT PRESENT

(F 1) CORPORATE PROFILE (1)
Employees about 90 thousands including employees of overseas NEC family companies, which are more than 10 thousands.

Net sales is 9 billion US Dollars.
As you see, we are growing rapidly and steadily.

3.1.2 OUR OVERSEAS CUSTOMERS

(F 2) CORPORATE PROFILE (2)
(F 3) CORPORATE PROFILE (3)
30 to 40% of NEC's total sales is for overseas customers. Among others, Telecommunications Administrations and Operating Agencies are the most important customers. In terms of region, Asia/Pacific is, of course, by far the most important.

3.1.3 MAJOR PRODUCTS

(F 4) CORPORATE PROFILE (4)
One of the reasons why we call our company a C & C company is our major products are in the fields of Communications and Computers. In addition, NEC is one of the largest manufacturers of the most advanced integrated circuits and other electron devices. They are, of course, the essential components of the sophisticated communication and computer products.

3.2 SUBJECT 2
INTERNATIONAL TRAINING ACTIVITIES

3.2.1 WHAT IS NEC INTERNATIONAL TRAINING?

It is NEC corporate activities for engineers and other staff of:
Overseas Customers
NEC Overseas Dealers and Distributors
NEC Overseas Family Companies

In addition, we serve for other foreign nationals who are not directly connected with our businesses, but are sponsored by the public organizations like governments, JICA and ITU.

3.2.2 TRAINING ACTIVITIES - WORLDWIDE

(F 5) TRAINING MAN/DAYS
(F 6) NUMBER OF TRAINEES
The chart shows training man/days NEC carried out during 1984. This figure does not include the training for NEC family companies. In other words, it shows the scale of NEC international training for overseas customers and dealers/distributors.

Please note that our training is served not only in Japan, but in various parts of the world. In fact, NEC international training is more active in outside of Japan. It is really on a global basis because our customers are in 144 countries of all over the world.

This chart is in terms of persons who received NEC training for 1984. Employees of NEC overseas companies are also not included. The total of 13,200 is really a big fiture.

3.2.3 TRAINING IN JAPAN

(F 7) TRAINEES AT NEC - JAPAN (BY NUMBERS)
(F 8) TRAINEES AT NEC - JAPAN (BY REGION)

The chart shows number of overseas trainees received at NEC, Japan for past 20 years. NEC Tokyo received more than 1,000 guest trainees in each of recent years. We expect about 1,500 trainees for this year. It is rapidly increasing.

If we see this by region, you will note that we are receiving Asian friends by far the most. We also note that trainees from USA and European countries are steadily increasing.

In average, we have more than 230 overseas trainees everyday in Japan. Since the average number of trainees per course is 4 to 6 persons, NEC Tokyo carries out 40 to 50 courses every day through the year for our overseas trainees. It is really a big operation.

3.3 SUBJECT 3
TRAINING ORGANIZATIONS AND FACILITIES

3.3.1 TRAINING ORGANIZATIONS

(F 9) TRAINING ORGANIZATIONS
Top management of NEC is well aware of the importance of the international training. A top management level committee called the 'International Training Committee' functions as a top policy board on important training policies. The Committee is headed by a top executives of the company.

3.3.2 I.E.T.C.

NEC International Education & Training Center is a headquarter division to administrate and coordinate the entire international training operations of NEC. The Center also acts as a secretariat of the Top Committee.

3.3.3 OPERATING ORGANIZATIONS

The Center itself operates such general or basic training as Orientation, Basic technology and Language. On the other hand, most of specialized or professional courses are operated by the various product divisions appearing in blue color on the chart.
Further, we have many division companies and local training centers outside of Japan. They specialize in operation, maintenance and training

Training organizations and their respective staff are collaborating very closely to complement the each other's functions and we are in a very good balance of the centralization and decentralyzation of the corporate training operations.

Taking NEC Tokyo alone, there are more than 30 training executives and managers, 40 full-time coordinators, 60 supporting staff. We have about 60 full-time instructors in Tokyo, with some 800 part-time instructors participating in the courses annually who are design/development engineers or other experts of the most advanced NEC technologies.

3.3.4 GLOBAL MAP OF TR. FACILITIES

(F10) GLOBAL MAP - TR. FACILITIES

The Map shows a global network or location of training facilities for NEC international training.

3.3.5 NEC EDUCATION CENTER FOR OVERSEAS TRAINEES

(F11) NEC EDUCATION CENTER FOR OVERSEAS TRAINEES

I.E.T.C. operates the central training facilities called 'NEC EDUCATION CENTER FOR OVERSEAS TRAINEES'. With training machine rooms, calss rooms and other special rooms, it can accommodate 300 trainees at one time.

3.3.6 GROUP TRAINING CENTERS

TAMAGAWA TRAINING CENTER
Especially for transmission technology.

(F12) T.T.C.
It's sketch. Blue colored portion is for practice.

(F13) YOKOHAMA TRAINING CENTER
Located at the site of world largest plant for microwave equipment, this center primarily serves for training in microwave, transmission and satellite telecommunications.

(F14) ABIKO TRAINING CENTER
This is a new center for most advanced digital technology.

(F15) FUCHU TRAINING CENTER
This Center is for computers hardware maintenance.

As a whole, these training centers form a facilities system for international training in Tokyo, sometimes combined with in-factory or in-site training.

3.3.7 NEC TAKAIDO HOUSE

(F16) NEC TAKAIDO HOUSE
A lodging facilities in downtown Tokyo exclusively for overseas trainees. Accommodate 100 guests. First-class hotel type. With self-cooking kitchens.

3.4 SUBJECT 4
TRAINING COURSES

3.4.1 ESSENTIAL OF NEC COURSES

Most of NEC courses are professional and specialized, deeply connected with the customer's project concerned. NEC courses, particularly those related to systems and equipment, should be organized so that they may be flexible and reflect the nature of the customer's project. NEC has considerable experience in developing and implementing such course for a wide range of telecommunications fields.

3.4.2 WIDE RANGE OF SUBJECTS COVERED

NEC courses cover the full range of NEC technological fields including computer, communications and industrial electronics applications. They also include basic and more advanced technology as well as fundamental theory and practical training. As a result, NEC can organize courses of diverse nature based on specific customer needs.

3.4.3 NEC COURSES - WIDE RANGE OF SUBJECTS

Digital Switching Systems
Transmission Systems
Microwave/Satellite Communication Systems
Radio & Broadcasting Systems
Computers
Industrial/Office Automation
LSI, IC and other Components
Production/Quality Control

3.4.4 OBJECTIVE AND STRUCTURE OF TRAINING COURSES

3.4.4.1 OBJECTIVE

Most training courses at NEC are provided as a part of the supply contract for NEC systems and equipment. The primary objective of these courses is to provide professional knowledge on the technology of the systems and equipment concerned.

3.4.4.2 COURSE STRUCTURE

(F17) TYPICAL COURSE STRUCTURE - TRANSMISSION
(F18) TYPICAL COURSE STRUCTURE - DIGITAL SWITCHING
The typical basic course structures are shown in (F17) and (F18). They are aimed at efficient operation and maintenance of the systems and equipment to be supplied. The basic structures are designed so that they may be flexibly modified or improved depending on the specific conditions involved and the needs or requirements of the users.

3.4.4.3 COURSE ORGANIZATION

(F19) TRAINING COURSE ORGANIZATION - 1
(F20) TRAINING COURSE ORGANIZATION - 2
An example of course organization in case of the digital switching courses is shown in (F19) and (F20).

3.4.4.4 SUPPORTING COURSES

In addition to professional or specialized courses, various supporting-type courses are provided to attain respective objectives of the training. For example,

a) ORIENTATION

NEC International Education & Training Center gives trainees guidance and information on training schedules, life in Japan, NEC as a company and NEC training personnel.

b) GENERAL EDUCATION

Additional information is also provided in detail on NEC as well as Japanese lifestyle, history, economy and culture.

c) LANGUAGE TRAINING

Good communication between instructors and trainees is vital if a training program is to be successful. Language barriers must be minimized. NEC can arrange for trainees to be taught in either Japanese or English.

d) BASIC TECHNOLOGICAL TRAINING
NEC offers two basic technological training courses:

d-1) Introductory course covering mathematics, physics, and basic electricity and electronics.

d-2) Basic technology course as groundwork for professional training in this area.

3.5. SUBJECT 5
FEATURES

3.5.1 FEATURES 1

(F21) FEATURES OF NEC TRAINING (1)

3.5.1.1 CUSTOMER - ORIENTED

About 40 percent of NEC sales is from overseas customers such as telecommunications administrations and operating agencies. We naturally are very keen to hear of their training needs. We try our utmost to adapt to their requirements.

3.5.1.2 FLEXIBLE COURSE DESIGNING

As a result, NEC international training can be featured as very flexible, including for the aspect of course designing.

3.5.1.3 REQUIREMENT FOR FLEXIBILITY

Why we should be flexible may be explained by the following reasons.

3.5.1.3.1 NEEDS VARY CUSTOMER BY CUSTOMER

Number of trainees varies. Level of trainees are so widely different. Requirements for time and period different. And objectives also vary.

3.5.1.3.2 COST

Usually, the training cost is agreed on as a part of the equipment supply contract. As a matter of fact, the level or content of training is affected by whether the agreed cost is sufficient for the objectives or not. But still, we try to allocate as much budget as possible to the training. In many cases, we spend twice as high expenses as the agreed cost. Anyhow, flexibility is required to have the optimum training within the limitation of the agreed cost or the budget.

3.5.1.3.3 RAPID TECHNICAL PROGRESS

This is another factor. ---- PCM Transmission field, for example.

3.5.1.4 ADVANCED TECHNOLOGY

3.5.1.5 DEDICATED INSTRUCTORS

3.5.1.6 EFFECTIVE TRAINING

3.5.2 FEATURES 2

(F22) FEATURES OF NEC TRAINING (2)

Further features are:

RECOGNITION BY TOP MANAGEMENT
As top executives of a C & C company, they are fully aware of the importance of international training.

ESTABLISHED ORGANIZATIONS/FACILITIES
This was referred to earlier in this presentation.

I also referred to "Trainees' Welfare". To add a few words, our Home Visit system is very popular to our trainees. In addtion, my center runs various welfare systems.

Continual Upgrading & Strengthening is what is going on in NEC international training because this business is still young for NEC in its 100 years' history.

3.6. SUBJECT 6 EFFORTS FOR FUTURE IMPROVEMENTS

3.6.1 CUSTOMER/NEC COOPERATION

First, the both sides need earlier information in regard to the training agreed in general in the contract. Second, we should find a certain way where training managers can participate in the negotiations on the training portion of the contract. Third, as a manufacturer, we hope the customer organization such as a purchasing department or its staff understand the importance of training and do accept the necessary cost for training.

3.6.2 COMPUTER SUPPORTED TRAINING

Computer can be utilized in various aspects of training. For example, it is widely introduced in the training management and administration. Today, however, I'd like to mention to its application to the instructional techniques, namely, its application area generally called as CAI. The CAI system used in our customer training is characterized by the very unique and effective method for course development on the basis of ISM (Interpretive Structure Modelling) Teaching Objective Structure Chart Analysis system and teaching material production by CAI Courseware Authoring System (Lessomwriter) developed by C & C System Research Laboratory of NEC Corporation. The atmost benefit of our system is that no program language is required for producing CAI training courses. Also, it can save time enormously. Our system will reduce your CAI course production time to only 1/8 of the conventional system. Our training will be greatly advantaged by the maximum utilization of our new CAI course development system.

3.6.3 EFFECTIVE USES OF TRAINING AIDS (AV, ETC)

In addition to new CAI approaches, many things are yet to be done on the effective or efficient use of conventional training aids such as Texts, Manuals, Handouts, Overheads, Slides,VTR Tapes.

3.6.4 SYSTEM APPROACHES

As referred to earlier in this presentation, our training is to be flexible in many aspects because of the varied conditions and requirements in each training case. This situation causes some difficulty in introducing the educational methodology which usually anticipates a large and uniform population. However, we are aware that efforts should be continued towards the effective training and the system approaches such as ITU TDG are to be further studied for possible introduction or adaptation to our training.

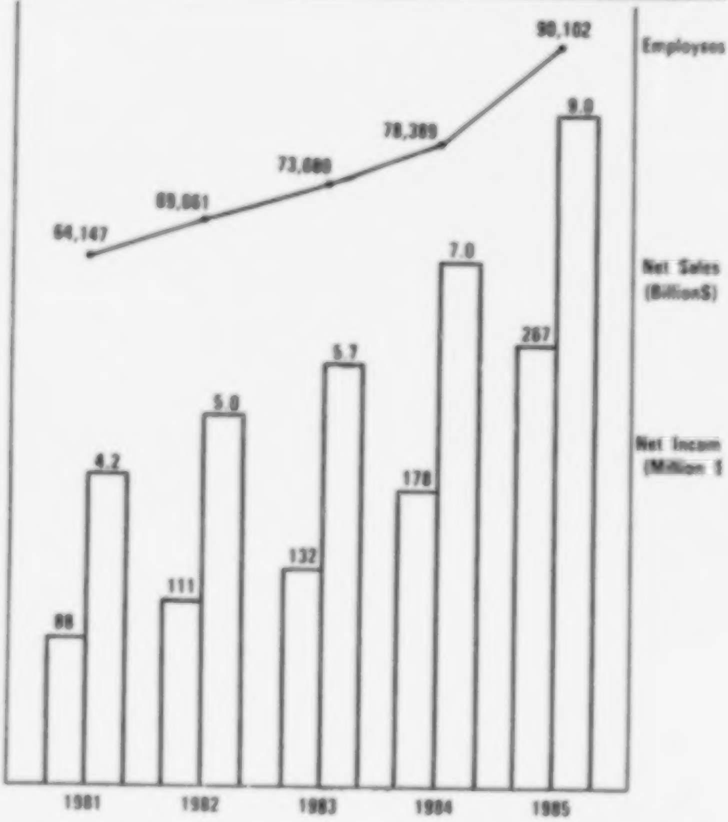
3.6.5 MINIMIZING LANGUAGE GAPS

3.6.6 TRAINING COST

NET SALES, NET INCOME AND EMPLOYEES

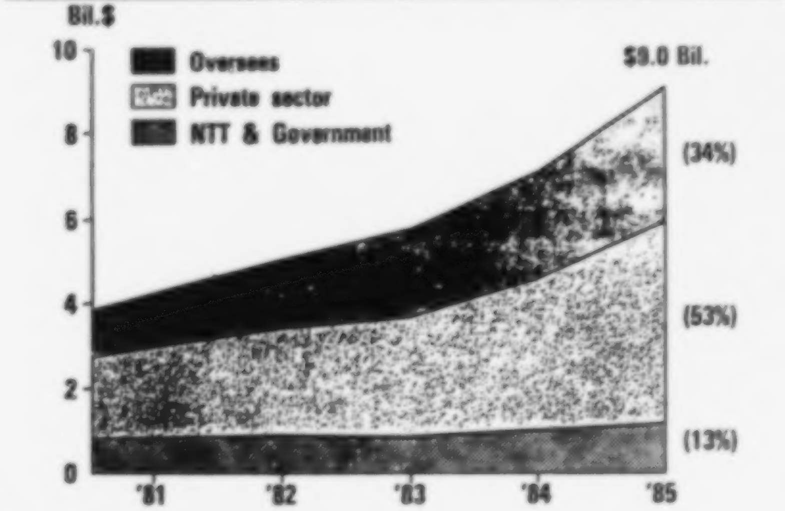
NEC
NEC Corporation

F 1: CORPORATE PROFILE (1)



SALES BY MAJOR CUSTOMER

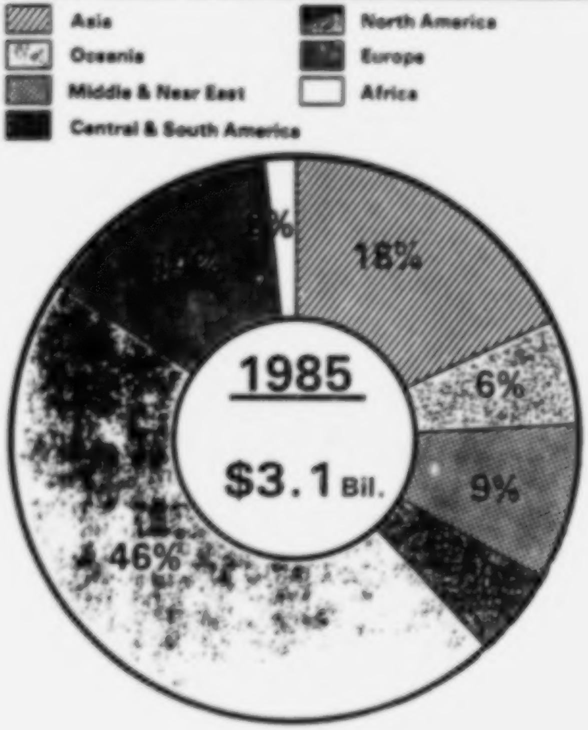
NEC



F 2: CORPORATE PROFILE (2)

INTERNATIONAL SALES BY REGION

NEC



F 3: CORPORATE PROFILE (3)

MAJOR OPERATIONS AND PRODUCTS

NEC
NEC Corporation

COMMUNICATIONS

- Telephone Switching System
- Transmission System
- Broadcasting Equipment/Fax
- Key Telephone
- Terminal

COMPUTERS

- Computer
- Word Processor
- Industrial Electronic System

MICRO ELECTRONICS

- IC, LSI, VLSI
- Discrete Devices

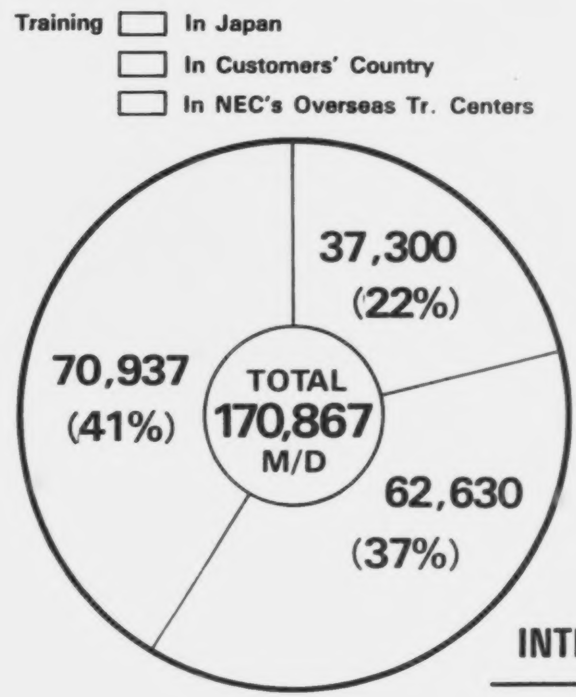
HOME ELECTRONICS

- VTR, TV, Tape Recorders and Radio Receivers
- Other Home Appliances

F 4: CORPORATE PROFILE (4)

INTERNATIONAL TRAINING NEC

Number of Training Man/Days (1984)

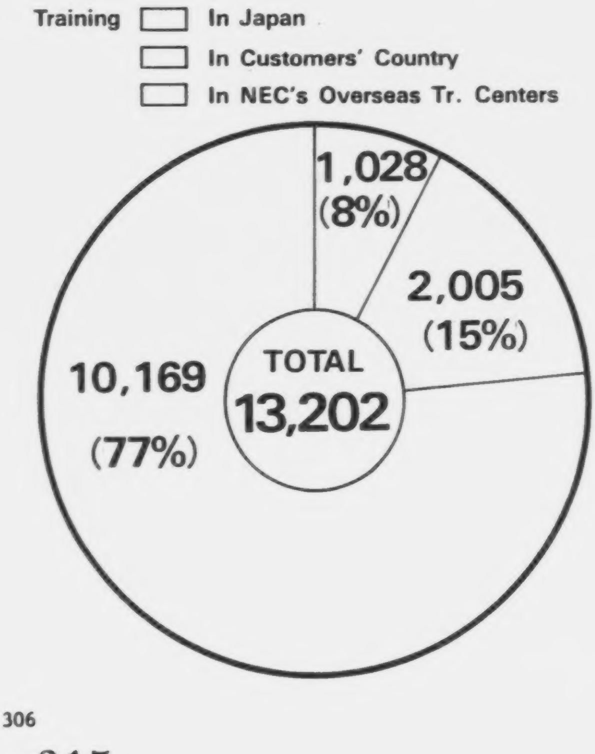


F 5: TRAINING MAN/DAYS

INTERNATIONAL TRAINING NEC

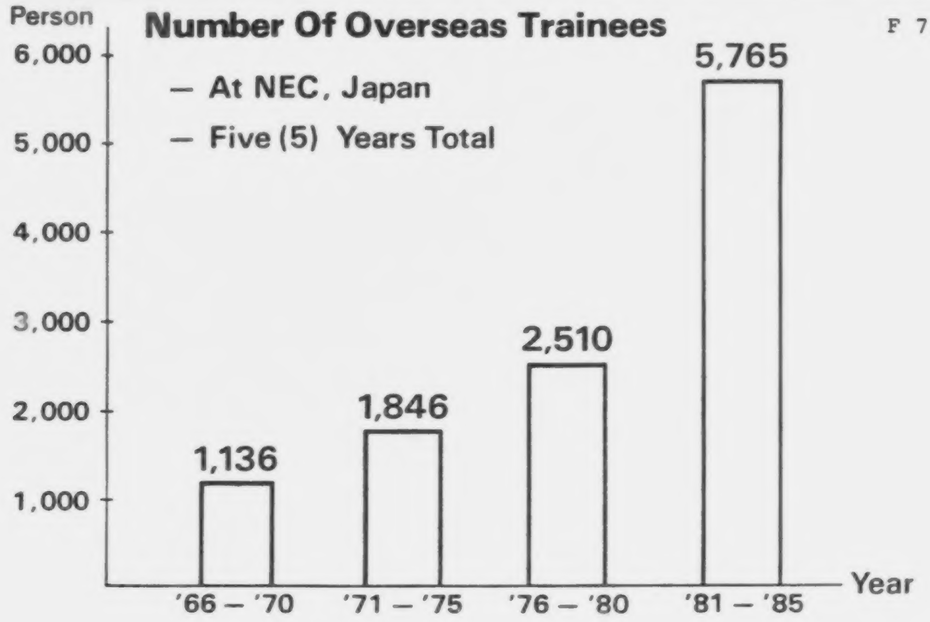
NEC Corporation

Number of Trainees (1984)



F 6: NUMBER OF TRAINEES

INTERNATIONAL TRAINING



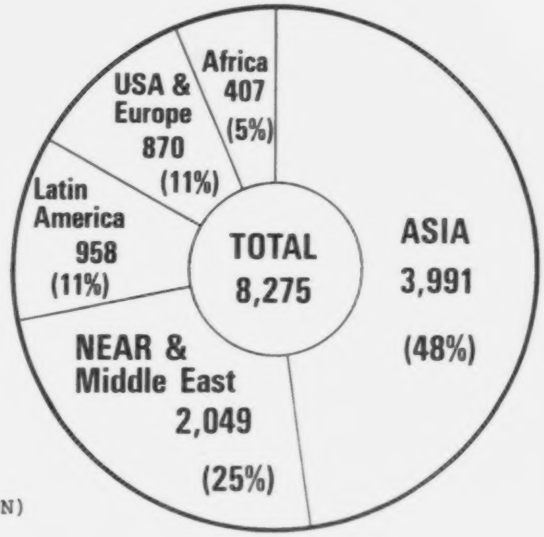
F 7: TRAINEES AT NEC - JAPAN (BY NUMBERS)

Number of Overseas Trainees

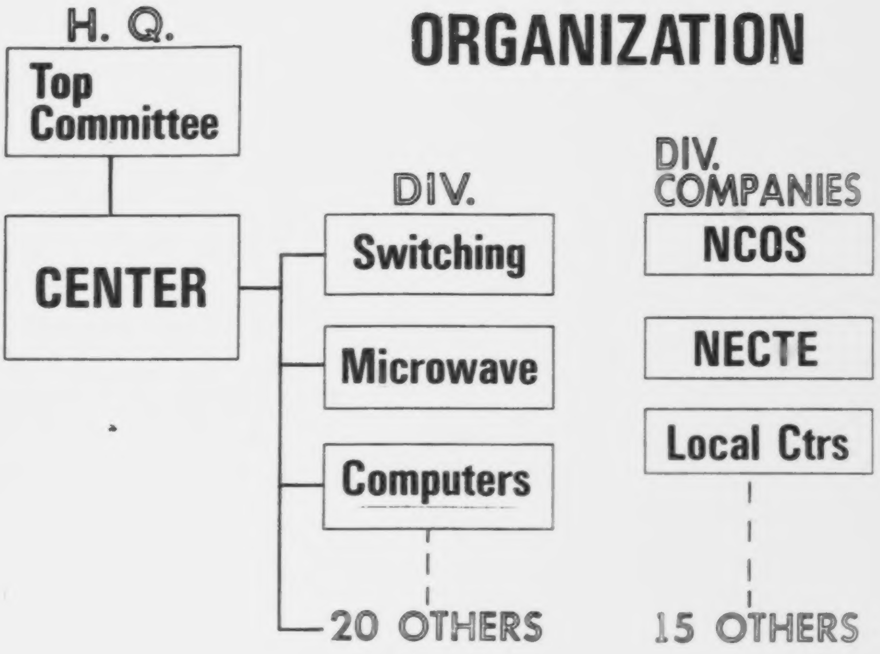
(By Region)

— AT NEC, JAPAN

— 1976～1985 Total

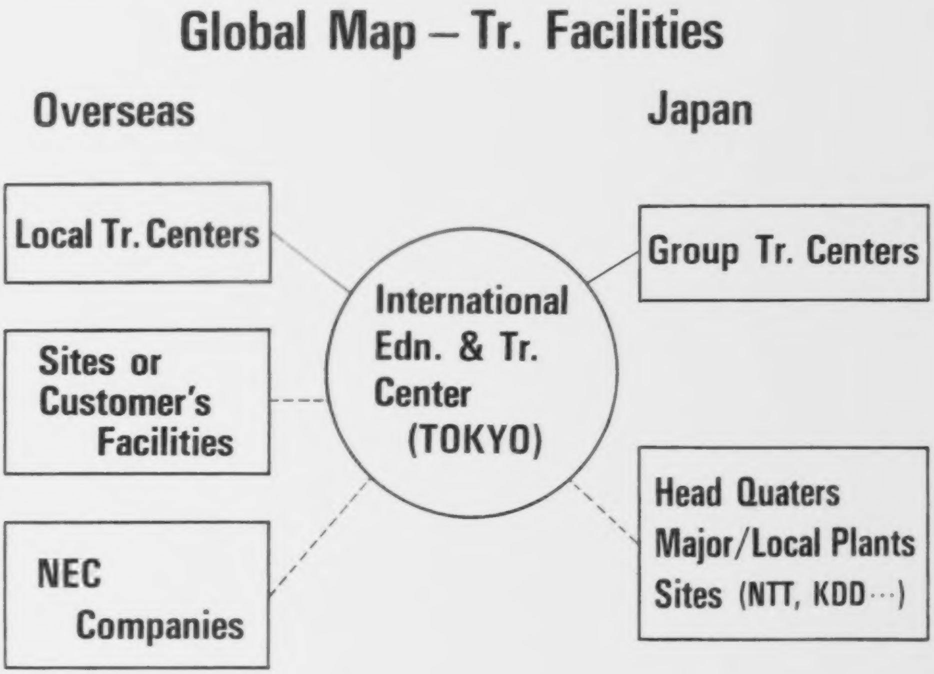


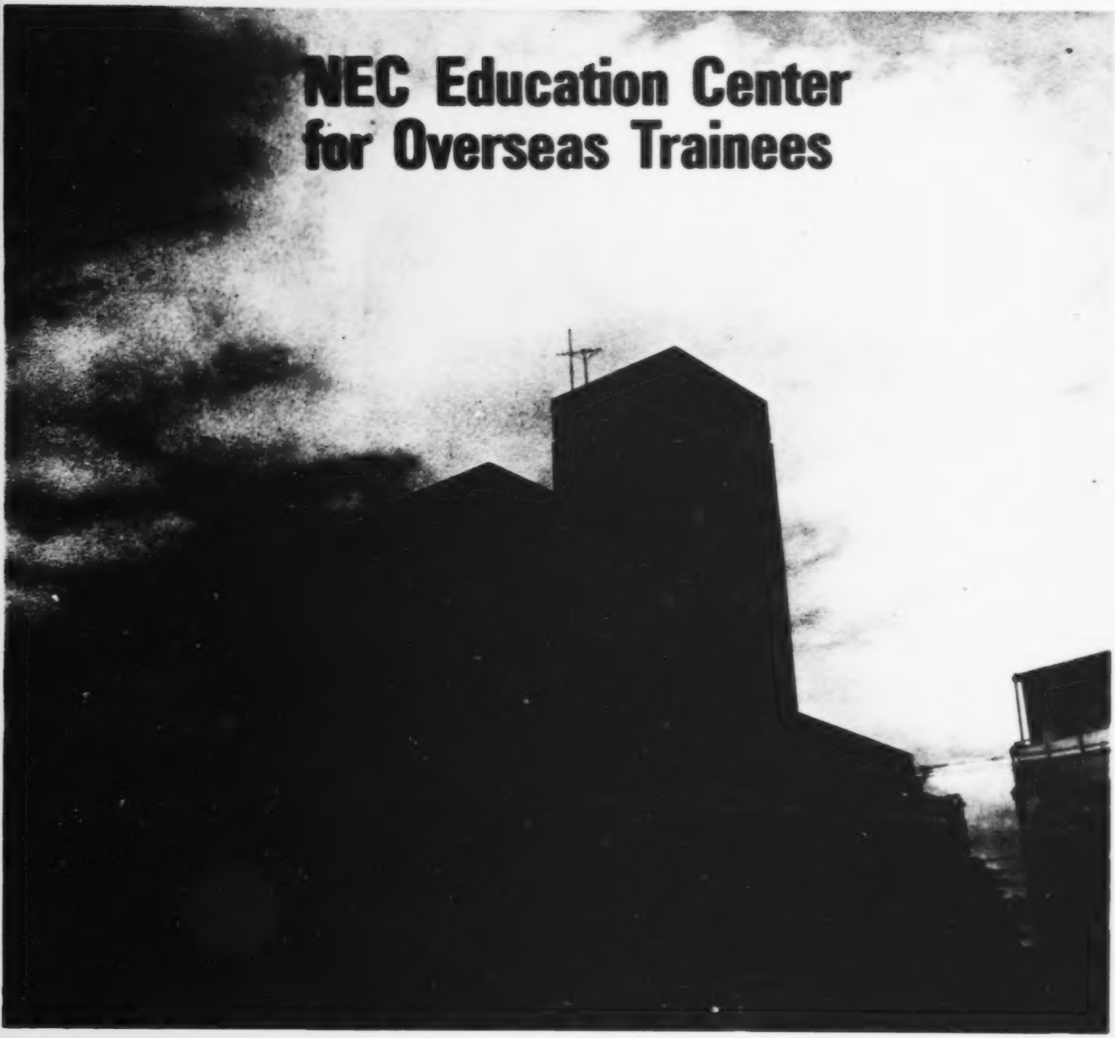
F 8: TRAINEES AT NEC - JAPAN (BY REGION)


ORGANIZATION
H. Q.
Top Committee
CENTER
DIV.
Switching
Microwave
Computers
20 OTHERS
DIV. COMPANIES
NCOS
NECTE
Local Ctrs
15 OTHERS

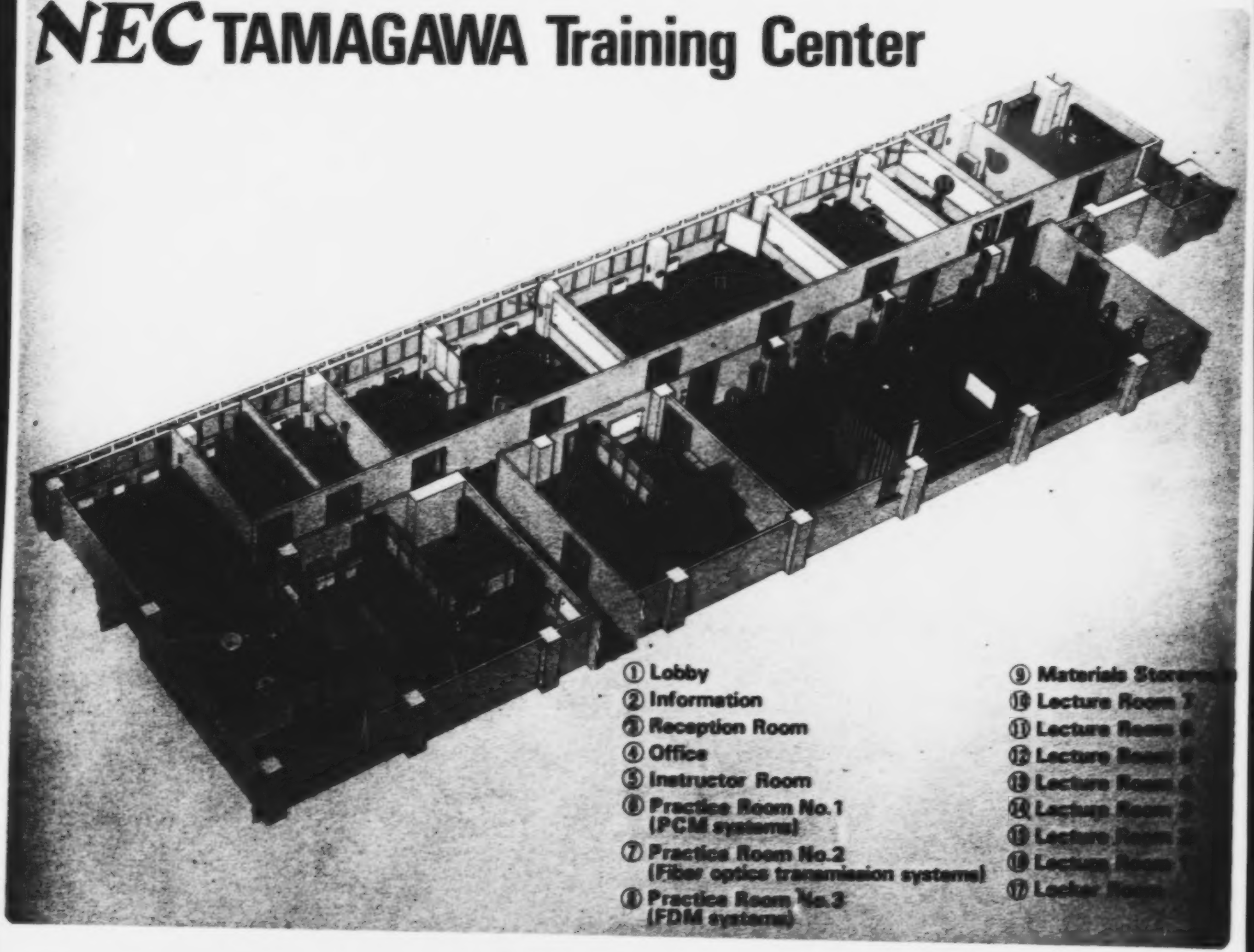
F 9: TRAINING ORGANIZATIONS

F10: GLOBAL MAP - TR. FACILITIES


Global Map – Tr. Facilities
Overseas
Japan
Local Tr. Centers
Sites or Customer's Facilities
NEC Companies
International Edn. & Tr. Center (TOKYO)
Group Tr. Centers
Head Quaters Major/Local Plants Sites (NTT, KDD···)


NEC Education Center
for Overseas Trainees

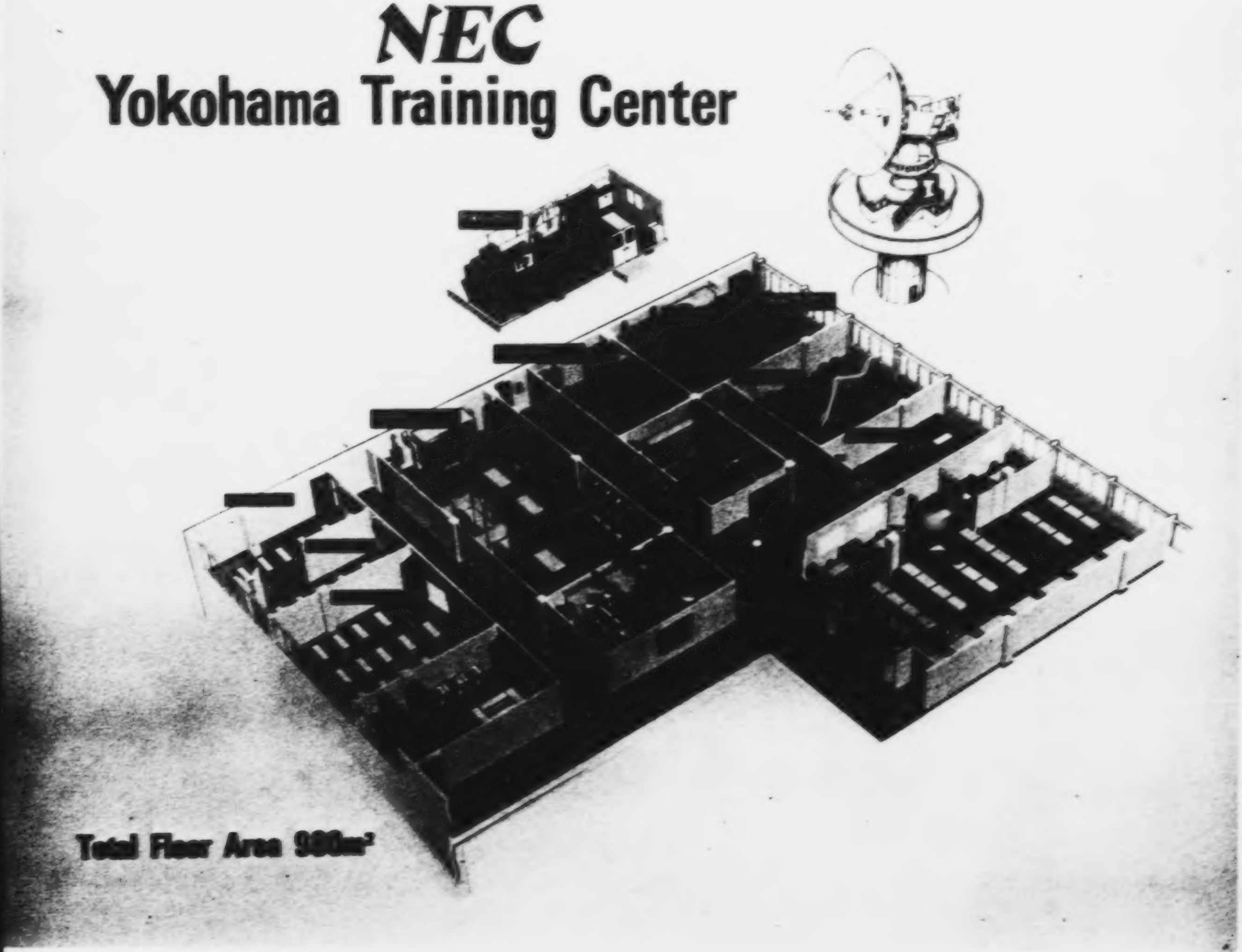
F11: NEC EDUCATION CENTER FOR OVERSEAS TRAINEES



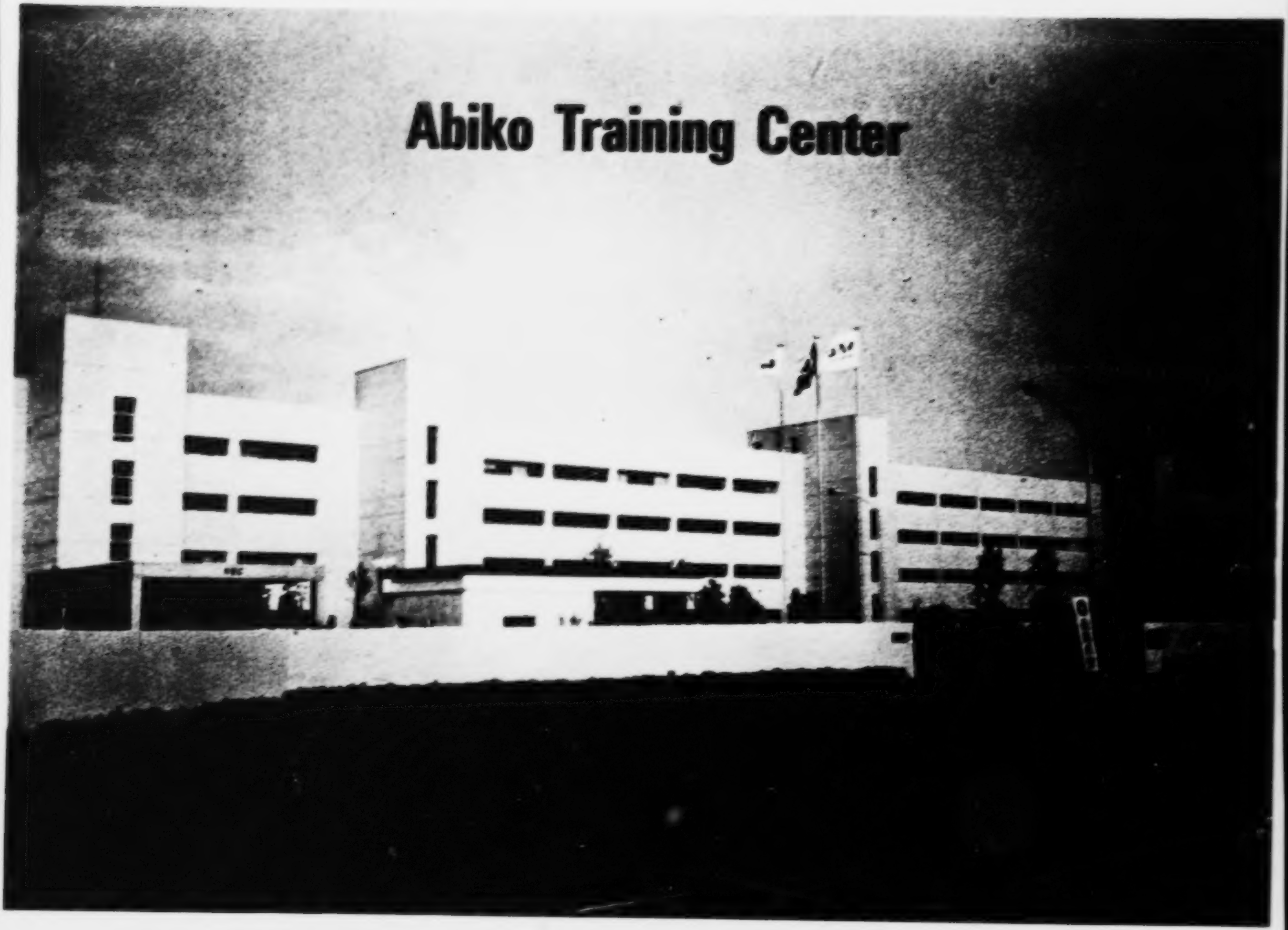
NEC TAMAGAWA Training Center

① Lobby
② Information
③ Reception Room
④ Office
⑤ Instructor Room
⑥ Practice Room No.1 (PCM systems)
⑦ Practice Room No.2 (Fiber optics transmission systems)
⑧ Practice Room No.3 (FDM systems)
⑨ Materials Storeroom
⑩ Lecture Room 7
⑪ Lecture Room 6
⑫ Lecture Room 5
⑬ Lecture Room 4
⑭ Lecture Room 3
⑮ Lecture Room 2
⑯ Lecture Room 1
⑰ Locker Room

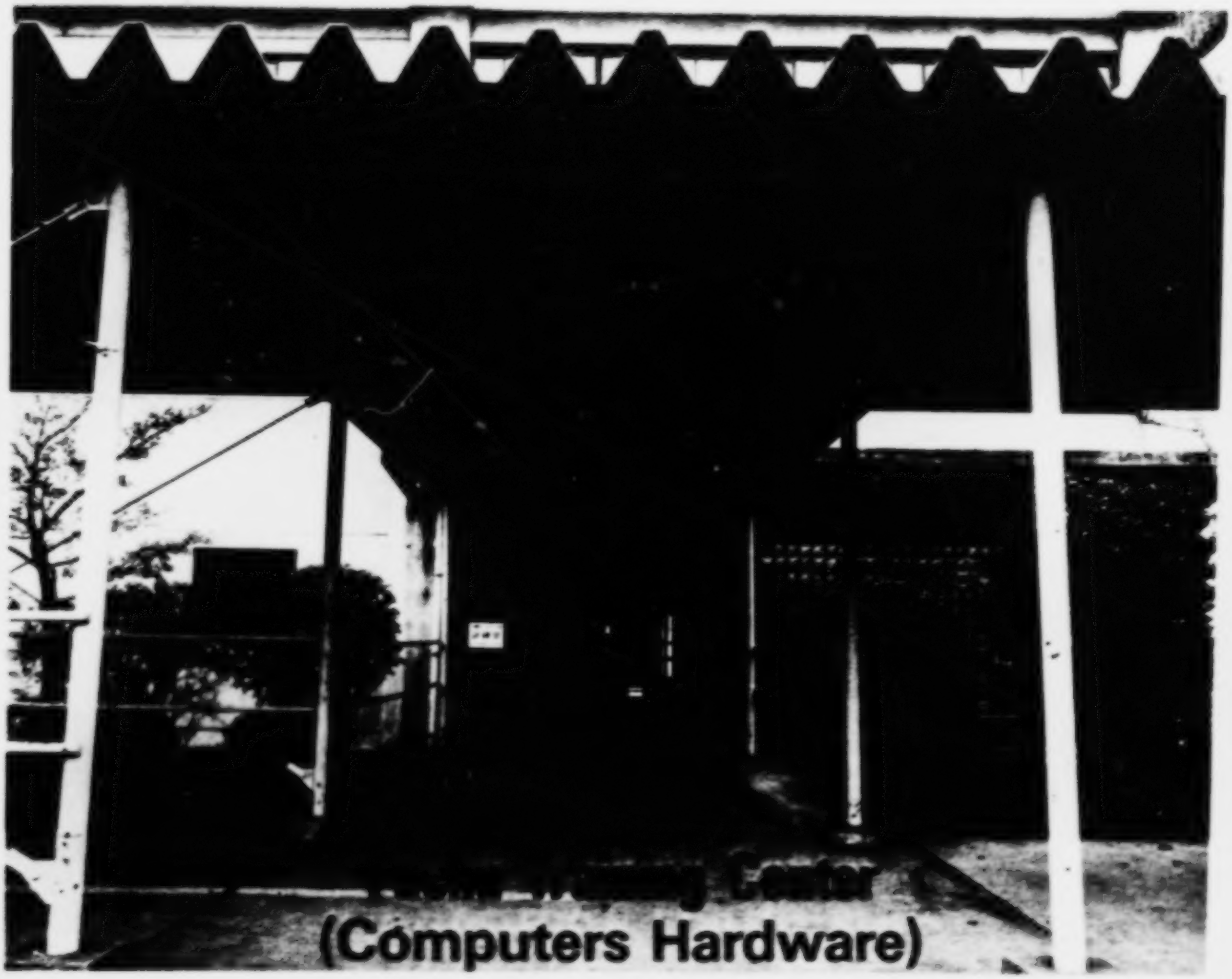
F12: T.T.C.


NEC
Yokohama Training Center
Total Floor Area 980m²

13: YOKOHAMA TRAINING CENTER

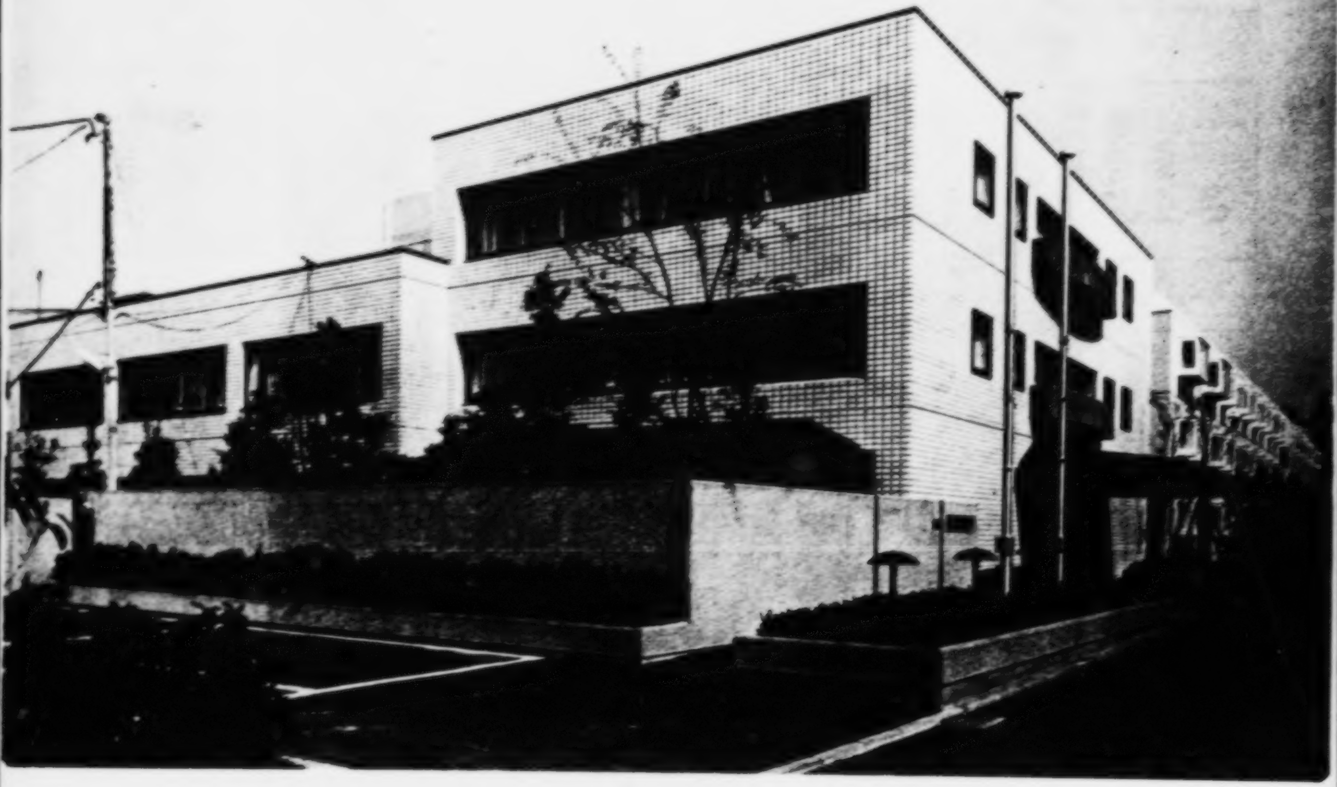

Abiko Training Center

F14: ABIKO TRAINING CENTER


(Computers Hardware)

F15: FUCHU TRAINING CENTER

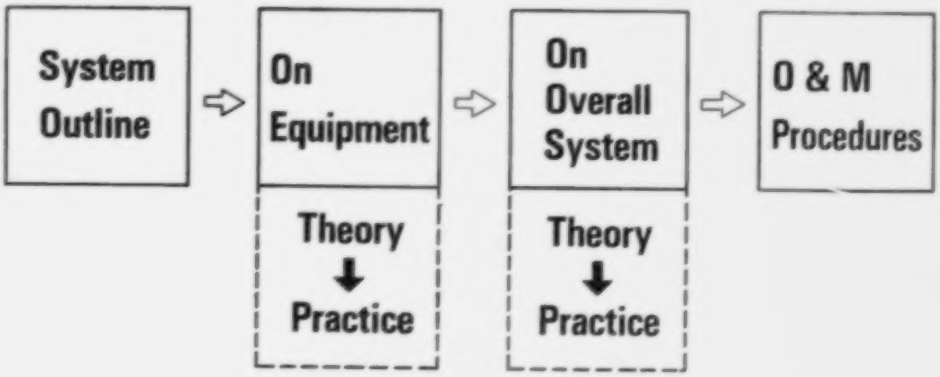
NEC Takaido House



F16: NEC TAKAIDO HOUSE

Typical Course Structure (1)

— Transmission Systems —


System Outline ⇨ On Equipment ⇨ On Overall System ⇨ O & M Procedures

Theory ↓ Practice

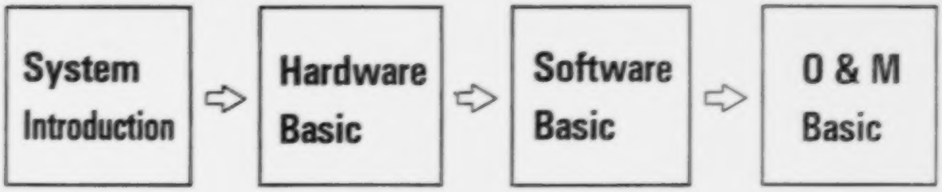
Theory ↓ Practice

F17: TYPICAL COURSE STRUCTURE - TRANSMISSION

Typical Course Structure (2)

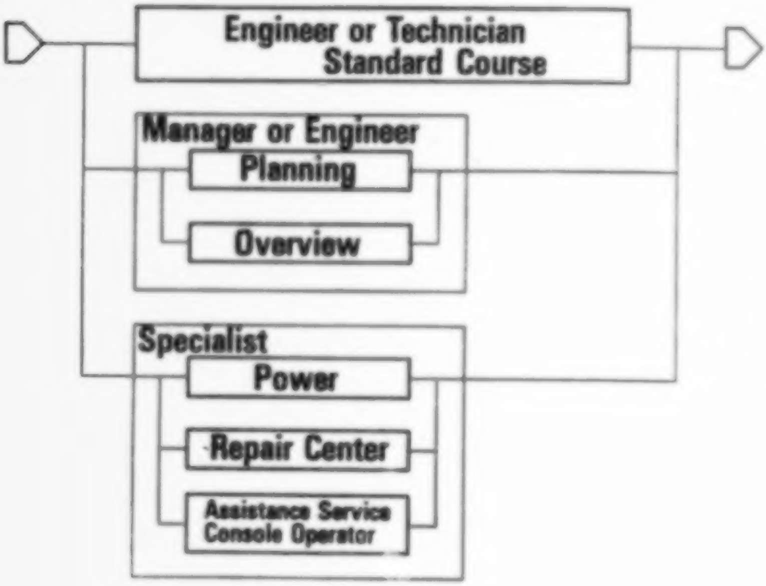
— Digital Switching —

Standard Course


System Introduction ⇨ Hardware Basic ⇨ Software Basic ⇨ O & M Basic

F18: TYPICAL COURSE STRUCTURE - DIGIRAL SWITCHING

Training Course Organization (1)



Engineer or Technician Standard Course

Manager or Engineer

- Planning
- Overview

Specialist

- Power
- Repair Center
- Assistance Service Console Operator

F19: TRAINING COURSE ORGANIZATION - 1

Training Course Organization (2)

Additional Courses

Hardware Engineer

- Hardware-Advanced

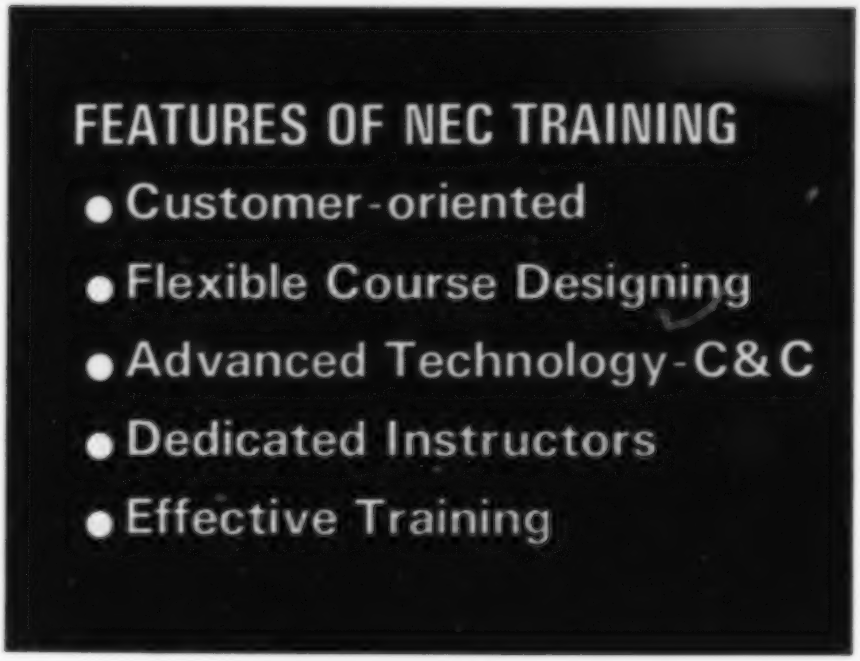
Software Engineer

- Software-Advanced

Engineer or Technician

- Installation
- Operation & Maintenance-Advanced

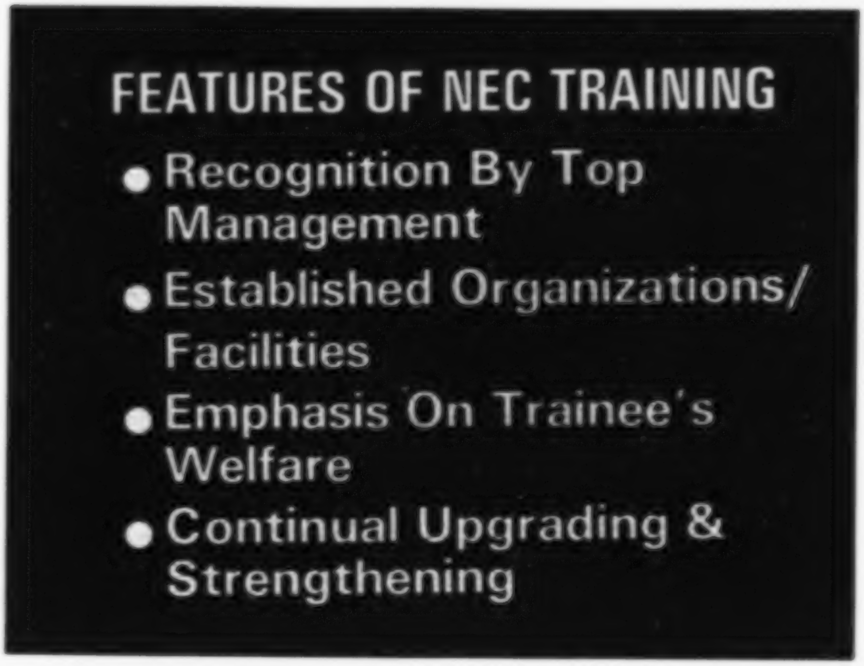
F20: TRAINING COURSE ORGANIZATION - 2



FEATURES OF NEC TRAINING

- Customer-oriented
- Flexible Course Designing
- Advanced Technology-C&C
- Dedicated Instructors
- Effective Training

F21: FEATURES OF NEC TRAINING (1)



FEATURES OF NEC TRAINING

- Recognition By Top Management
- Established Organizations/ Facilities
- Emphasis On Trainee's Welfare
- Continual Upgrading & Strengthening

F22: FEATURES OF NEC TRAINING (2)

TRAINING AND EDUCATION IN THE TELECOMMUNICATIONS FIELD

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ABSTRACT

With the steady development of the information society, the role of telecommunications systems is becoming important, which in turn is giving rise to a great demand for the education of telecommunications engineers. This paper discusses the education of engineers in the telecommunications field. It starts by analyzing educational needs, then proceeds to the present situation of education and problems arising from it. Next it describes the use of a computer-assisted learning (CAL) system, centering on its applications and effects. Finally, it introduces a telecommunications CAL system, EXCEL, which we are now developing, by reporting its features, the hardware configurations in which EXCEL can be used, and curricula provided, and a teaching material development support system.

1. INTRODUCTION

Nowadays, thanks to development in the fields of computers and telecommunications, the construction of an advanced information society is steadily progressing. Telecommunications systems, which will occupy a central position in such a society, are needed to provide many reliable high-level services. Accordingly, they are becoming increasingly complex and varied. There has been a remarkable increase in the number of types and quantity of systems already in operation. As a result, an ever-increasing level of technical competence is being required of an ever-increasing number of personnel engaged in the development, maintenance, and operation of these systems.
If high-reliability systems are to be produced, an educational program, which matches rapid technical improvements, can be taught to many engineers at a time, and is uniform in quality, must be devised.

On the other hand, thanks to hardware improvements, many high-performance, low-priced microcomputers, workstations, and video disks are now being introduced into offices. The computer-assisted learning (CAL) system that we are now constructing uses various facilities provided by such equipment.

2. PRESENT SITUATION OF ENGINEERS' EDUCATION

As telecommunications systems are becoming increasingly advanced and varied, the importance of engineers' education is growing but, at the same time, the material to be covered is rapidly expanding. To provide an optimal education, an engineer's exact educational needs must be known, these needs must be analyzed, and an appropriate educational method must be selected.

The discussion starts by describing the present situation of the education of telecommunications engineers and the associated problems.

2.1 Telecommunications engineers' configuration

Telecommunications engineers can be broadly classified into system developers, maintenance personnel, and operators, as shown in Figure 2.1. System developers can be further classified into project managers, system engineers, and programmers. Therefore, the educational courseware should provide for their individual jobs.

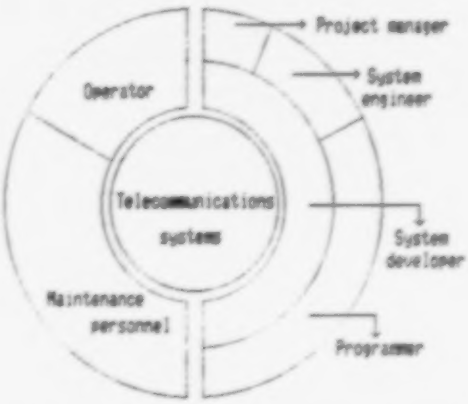


Figure 2.1 Engineers in telecommunications field

2.2 Needs and Method

Table 2.1 shows the necessary education for the engineer groups shown in Figure 2.1.
From this table, it is apparent that the development or operation of a reliable system requires a large amount of knowledge and skill on the part of the engineers in every group.

Broadly speaking, education is now provided in either of two ways. In the first way, lecturers are given according to a certain curriculum for a certain period of time. When a new system is installed, lectures are given to those engineers who will be involved with that system. Lectures are also given to middle-class engineers and project leaders as needed. The second way is by means of on-the-job training. In this method, trainees acquire knowledge and technique from the actual work in which they are engaged. A trainer is in attendance. They are trained to attain

Table 2.1 Engineers in telecommunications field and educational needs

knowledge, Techniques	System developers			Maintenance personnel	Operators
	Project managers	System engineers	Programmers		
Switching systems (general)	◎	◎	○	○	○
Switching systems (hardware)	◎	◎	◎	◎	
Switching systems (software)	◎	◎	◎	◎	
Programming language	◎	○	◎		○
Programming techniques	◎	○	◎	◎	○
Testing techniques	◎	○	◎	◎	○
Development techniques	◎	○	○	○	
Project planning	◎	○			
Project management	◎	○			
Software quality management	◎	○	◎		
Daily operation and maintenance	○	○		◎	◎
Trouble shooting	○	○		◎	◎
Operation file management	○	○			◎

◎ : expertise knowledge ○ : basic knowledge

targets following given procedures and to do actual work, and their achievement is checked.

Currently, education in the telecommunications field combines the two methods.

2.3 Problems with Present Education

As stated earlier, it is anticipated that telecommunications systems will continue to develop rapidly, thus generating an increasing demand for engineers. Unfortunately, the present educational system cannot cope with this trend and several problems have resulted. The major problems are listed below:

- There is an absolute shortage of trainers.
- Since work is subdivided more intensively and the required knowledge and skill are becoming more specific, there is a shortage of optimal trainers. (The engineers who possess this expertise and skill are engaged in project.)
- The need for education arises irregularly. (Periodic education only cannot meet the demand.)
- There is a trend that difference in the technical level of trainees is widening. Lectures cannot suit all trainees.
- The knowledge and skills that are learned from actual work experience are difficult to teach through lectures.

To eliminate the above problems, we are implementing a CAL system that uses microcomputers or workstations.

3. USE OF THE CAL SYSTEM FOR TRAINING ENGINEERS

3.1 Features of the CAL System

(1) Curriculum optimal to the student's experience

Curricula can be optimized for individual students who may have different technical experience, and different understanding abilities and who progress at different speeds.

(2) Knowledge and skills available as teaching materials

Experts' knowledge and skills are collectively managed, using data base, so can be used as teaching materials whenever needed.

(3) Management of students' result

Students' results are collectively managed, so the progress and understanding of individual students can be easily displayed. The progress and understanding of the students as a whole can also be displayed.

(4) Providing education wherever and whenever needed

Since learning proceeds through interactive conversation with a microcomputer, education can be provided to either a group or an individual at any place at any time.

(5) Easy change of curricula

Teaching materials and curricula can be easily changed to reflect technical improvements and educational needs.

3.2 Application of the CAL System

If we look at the features of the CAL system, we can see that many factors can help solve the problems in our present education system. Especially, since there is a shortage of trainers, the availability of expertise and skills from data bases is very attractive. It allows uniform quality of education whenever and wherever education is provided.

It seems impossible, however, for the CAL system to provide all necessary education. There is a limit to the capability of the present CAL system and at the same time, there is presently no substitute for man-to-man instruction in certain fields. Therefore, it is important to decide what can be best taught by the CAL system and what should be thaught man-to-man.

Table 2.1 also shows that there is a certain core of knowledge and skill that is common to all engineers. After we carefully studied the features of the CAL system and the contents of Table 2.1, we concluded that the best educational results are obtained when the CAL system is used to teach the following items:

- Basic knowledge and standard techniques

  Basic knowledge of general telecommunications systems', and standard development techniques such as basic software configuration rules, individual development techniques, project management techniques, and programming techniques.

- Simulation

  Techniques such as project management, trouble-shooting, and system operation can be quickly learned through simulation games. In the past, these techniques were learned from experience.

We believe that about 80% of education can be provided by the CAL system. The rest should be provided either by instructors and the CAL system in combination, or by instructors alone, as was done previously.

4. TELECOMMUNICATIONS CAL SYSTEM, EXCEL

Given the results of the previously mentioned study, we are developing a CAL system, EXCEL, for the education of telecommunications engineers. The following describes the features, configuration, and the functions of EXCEL.

4.1 Features of EXCEL

(1) Providing specialist courseware

EXCEL separately provides specialist courseware for development engineers, maintenance personnel, and operators. The level of the courseware ranges from basic to expert. Thanks to this, the curricula can be optimized for individual engineers. The curricula can be used not only for those who wish to obtain new knowledge and skills but also for those who wish to maintain their technical levels.

(2) Diagnosing level of understanding

Based on their learning records, EXCEL shows each engineer their achievement level in an easy-to-understand graph. For trainers, EXCEL supplies such data as learning traces and required time. Trainers use this data to check the achievement level of each engineer and to update teaching materials.

(3) Enabling simulation

EXCEL supports simulation games so that engineers can obtain knowledge and skills such as project management, system operation, and trouble shooting that are usually obtained through actual work experience. For example, engineers can simulate what to do in the case of a message indicating a problem during an operation or in the case of a message indicating traffic congestion.

(4) Allowing easy management of courseware

EXCEL provides many tools to help create, update, and manage courseware.

4.2 Hardware Configuration

EXCEL can be used with two types of hardware configuration.

- Standalone type

  Basically, all sets of courseware can be used on a standalone basis. The standalone type is suitable for education in remote locations such as distributed offices and debug centers, and for supplementary use in preparation and the review of lectures. Learning results are collected for centralized management after completion of each course.

- Centralized type

  The centralized type is suitable for the education of a certain number of people for a certain period of time such as the training of engineers at system installation.

Figures 4.1 shows standalone-type and centralized-type hardware configurations.

4.3 Functions

(1) Teaching function

EXCEL supplies various teaching materials to trainees. They include knowledge and skills , and questions for checking a trainees' level of understanding. Engineers learn through interactive conversation with a microcomputer.

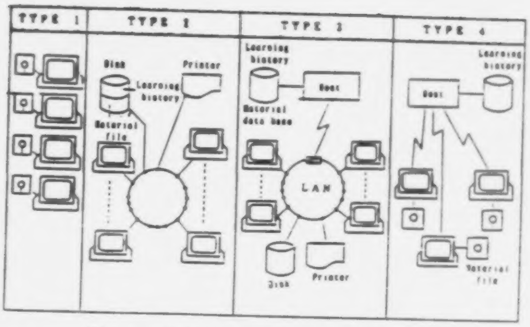


Figure 4.1 Hardware configurations

The following two points are essential to the teaching function:

Teaching materials best suited to individual trained engineers must be provided. This is accomplished by anticipating the trainees' answers. The system determines the next teaching materials according to the actual answers given by trainees.

The second is maintaining the trainees' interest. Training with a CAL system is apt to become monotonous because the teacher is a machine. Therefore, attractive teaching materials are required. The teaching materials must fully take advantage of machine features; they must stimulate emulation, appear to be games, and must have high quality voice services, graphics, and colors.

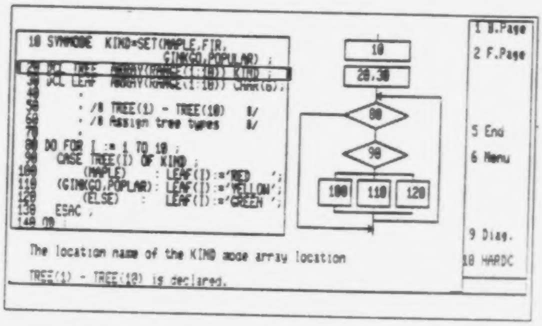
Figure 4.2 and 4.3 show teaching material's examples.

(2) Diagnostic function

EXCEL stores learning history in the learning recording file as trainee's study progresses. The major records in the file are learning traces, time, and answeres to the system's questions. The diagnostic function supplies useful data for both trainees and trainers based on the information in the file.

Generally, the level of understanding of a lecture or textbook is known only by tests and reports. In contrast, the diagnostic function of EXCEL examines the achievement level from various angles and shows the results in easy-to-understand graphs. From this objective data, students can find their weak points at an early stage of the study, and can compensate in the next stage.

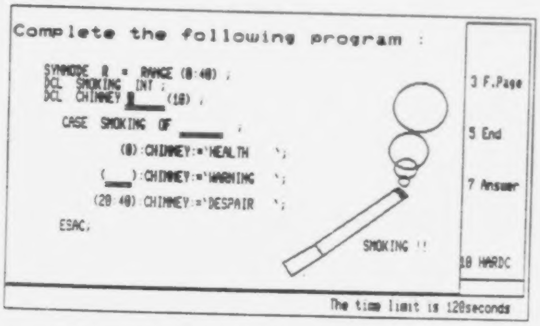
From the trainers' standpoint, the learning traces and required time reveal those points that are difficult to understand. So trainers can make up for insufficient teaching materials.
Figure 4.4 and 4.5 show diagnostic examples.



```
10 SYNMODE  KIND=SET(MAPLE,FIR,
                      GINKGO,POPULAR) ;
20 DCL TREE  ARRAY(RANGE(1:10)) KIND ;
30 DCL LEAF  ARRAY(RANGE(1:10)) CHAR(6);
40      .
50      . /* TREE(1) - TREE(10)    */
60      . /* Assign tree types     */
70      .
80 DO FOR I := 1 TO 10 ;
90   CASE TREE(I) OF KIND ;
100        (MAPLE)      : LEAF(I):='RED    ';
110    (GINKGO,POPLAR): LEAF(I):='YELLOW';
120        (ELSE)     :   LEAF(I):='GREEN  ';
130   ESAC ;
140 OD ;
```

The location name of the KIND mode array location TREE(1) - TREE(10) is declared.

Figure 4.2 Teaching material example I



Complete the following program :

```
SYNMODE R = RANGE (0:40) ;
DCL  SMOKING  INT ;
DCL  CHIMNEY R____(10) ;
  CASE  SMOKING  OF ______ ;
          (0):CHIMNEY:='HEALTH    ';
        (____):CHIMNEY:='WARNING   ';
       (20:40):CHIMNEY:='DESPAIR   ';
  ESAC;
```

The time limit is 120seconds

Figure 4.3 Teaching material example II

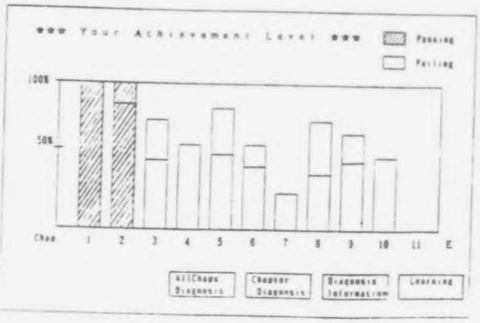
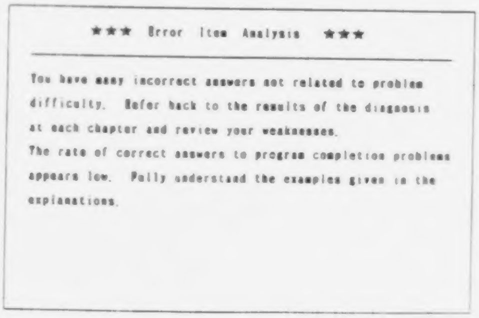


Figure 4.4 Diagnostic example I



*** Error Item Analysis ***

You have many incorrect answers not related to problem difficulty. Refer back to the results of the diagnosis at each chapter and review your weaknesses.
The rate of correct answers to program completion problems appears low. Fully understand the examples given in the explanations.

Figure 4.5 Diagnostic example II

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4.4 Curricula

Broadly speaking, EXCEL consists of three sets of courseware:

- Basic training course
- Expert training course
- Project managers' course

The expert training course is further divided into system developers' course and maintenance personnel's course.

Table 4.1 summarizes the three sets of EXCEL courseware system.

Table 4.1 EXCEL courseware system

EXCEL curricula		Contents	
Basic training course		Primer of switching systems	Provides basic knowledge of general switching systems, signaling systems, hardware, and software
		Primer of system development	Provides basic knowledge of system development from basic designing through functional designing and testing to maintenance
		Primer of programming techniques	Provides basic knowledge on programming languages and programming techniques
Expert training course	System developers' course	Development techniques	Provides expertise on software configuration, designing, programming, and development support tools
		Testing techniques	Provides expertise on testing techniques, and problem solving techniques
	Maintenance personnel's course	Daily operation and maintenance	Provides expertise on daily work such as traffic measurement, service order processing, operation file management, system operation, and maintenance
		Trouble-shooting	Provides expertise on how to deal with troubles such as system failures and traffic congestion
Project managers' course		Project management	Provides project planning knowledge and management skills from basic designing to project completion through simulation games
		Software quality management	Provides skills on system quality management at development stage and quality evaluation at finished stage

5. TEACHING MATERIAL DEVELOPMENT SUPPORT SYSTEM

The training effeiciency of the CAL system increases as more courseware is provided. Here arises a problem that if courseware is developed in a general-purpose programming language, it requires a large amount of manpower and a large amount of time.

To reduce the manpower and time required for courseware development, there must be an environment in which teaching material developers do not have to learn a special language to create, update, and manage teaching materials. They should be able to handle teaching materials easily by interactive conversation with a screen.

To this end, we have developed a teaching material development support system having the features, configuration, and functions described below:

5.1 Features

- Text can be easily input using a word processor.
- Graphics can be easily input using a mouse and a keyboard.
- Text and graphics can be easily displayed and updated.
- The data indicating learning progress can be easily generated, updated, and managed.

5.2 Configuration

Figure 5.1 shows the configuration of the teaching material development support system.

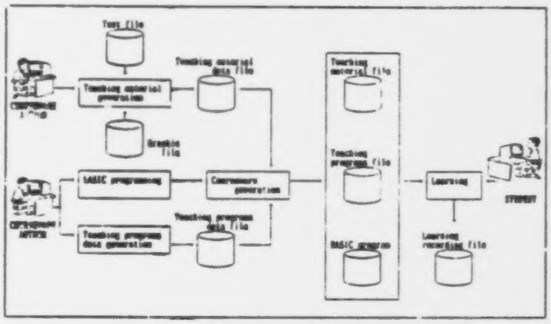

Figure 5.1 Teaching material development support system configuration

5.3 Functions

As shown in Figure 5.1, the teaching material development support system has three functions:

- Teaching material generation
- Teaching material assembly
- Teaching material execution

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The following describes these functions in details:

(1) Teaching material generation

The editor is used to generate teaching materials. Teaching materials consist of text (character data including Japanese) and graphics (graphic data). Text is stored in the text file, and graphics in the graphic file. Ordinary word processors can be used for text generation.

(2) Teaching material assembly

Teaching material assembly defines how to advance teaching steps.
In other words, it defines the order in which explanations are made. The order varies depending on the trainee's answers to the questions in the teaching materials. Teaching progress data is stored in the Teaching progress data file.

(3) Teaching material execution

Courseware produced through the generation and assembly steps must be executed at the learning stage. The courseware is executed by the learning progress program. The progress of individual trainees and information on trainees' answers are stored in the learning recording file.

Figure 5.2 shows the flow of courseware development.

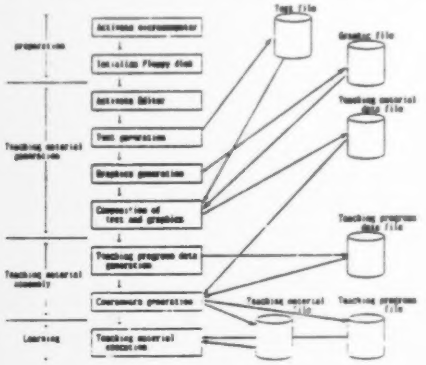
Text file
Graphic file
Teaching material data file
Teaching progress data file
Teaching material file
Teaching progress file
preparation
Teaching material generation
Teaching material assembly
Learning
Activate microcomputer
Initialize Floppy disk
Activate Editor
Text generation
Graphics generation
Composition of text and graphics
Teaching progress data generation
Courseware generation
Teaching material execution

Figure 5.2 Teaching materials creation procedure

6. ADVANTAGES OF THE CAL SYSTEM

(1) Study can start with a standalone-type and proceed to a centralized-type. A CAL system can be installed on a small initial investment.

(2) Since teaching materials are derived from experts' knowledge and skills, high-level education can always be provided.

(3) Teaching materials can be easily updated to reflect technological improvements. Curricula can also be easily compiled to answer any needs.

(4) Manpower required for education can be substantially reduced.

7. CONCLUSION

We presented out concept of the education of engineers in the telecommunications field and approaches to it using the CAL system. We believe we can provide effective education by widening the coverage of the CAL system and making the best use of microcomputer functions.

On the other hand, it is only a short time since the CAL system came into being and it has many problems to be solved. Although an ideal education would be totally man-to man, it is difficult to realize. Therefore, we must endeavor to get as close to the ideal as possible. We should also continue our efforts to find the optimal coverage by the CAL system and to provide an education environment supporting free use of artificial intelligence.

At the same time, we cannot ignore an ergonomic approach. After considering the physical effects of computers and the effects of an education environment, we should endeavor to construct an educational system that places the greatest importance on the trainee.

8. REFERENCES

[1] N. Ashiba, "Present and Future of CAL in the middle class education", FACOM journal, Vol.11. No.3. 1985

[2] FUJITSU, Teaching material generating support system "FMSCHOOL-ACE16" manual

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LOW-BUDGET TELETRAINING IN HAWAII

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Abstract

Low-cost alternatives to full-motion television can provide effective training where distances are large and classes and budgets are small. The two projects described here used audio, freeze- frame video and, in one case, computer conferences to link specialists in North America with classes in Hawaii.

While full-motion television can be useful for training, there are other forms of telecommunications which are less expensive, more versatile and, for many purposes, just as effective. This report describes two low-budget training activities which used audio, freeze-frame video and, in one case, computers to link classes in Hawaii with specialists in North America.*

Although using the same kinds of equipment and transmission facilities — the regular dial-up public telephone system — the projects contrasted widely in goals, duration, trainees and results.

One project was a half-day, one-time- only session to train teachers in the handling of NASA's moon-rock samples. The other was a semester-long course in which training emerged as an adjunct to the primary function, education.

The first project was a NASA certification program for science teachers wishing to use moonrocks in their classes. Such teachers must first attend a briefing covering two points: the scientific background of the rocks, and safeguards to protect the rare specimens against theft.

NASA's usual procedure is to send its information officer out to the school or college to conduct the four-hour certification session in person. In this case, however, he remained at his Washington DC headquarters and conducted the session over the telephone, using slow scan video, for the teachers 5000 miles away.

This was the first time NASA had conducted a remote certification session, and it worked very well. Information sheets and a film strip were mailed to Hawaii a week or so earlier, so the teachers had them on hand the morning of the session. The program opened with greetings from the principal of the school at which the teachers were assembled. Then, using two telephone lines, one for voice and the other for video, we contacted the NASA information officer in far away Washington. He could see and hear us, and we could see and hear him.

He outlined the session, gave some background and answered preliminary questions. When his distant audience seemed ready, he signed off for a while so that they could view the filmstrip and study the information sheets. Then he called us back, and the long-distance discussion resumed. After further questions and comments indicated that the teachers had indeed acquired the information and attitude he wished, the trainer brought the session to an end. A few days later each teacher received a regular NASA certificate in the mail, attesting to his or her successful completion of the training.

The teachers were pleased by this opportunity to update their scientific knowledge, which often lags behind that of their colleagues on the mainland. The observers from the nearby East-West Center, many of whom were from Asia and the Pacific, were intrigued by this demonstration of low-cost technology, which could be useful in their own developing countries. The producers of the event were relieved that it went smoothly. The NASA education officer felt that the session accomplished all that it was intended to; his only reservation was that it had eliminated a chance to visit Hawaii.

The second teletraining project was very different. A semester-long course about Silicon Valley, it featured long-distance interviews with scientists, technicians, business executives and other key participants in California's famed high technology center.

Speakers included the authors of the popular books being used instead of traditional texts, and representatives from Apple, Intel, Control Data, ROLM, Hewlett-Packard and other companies in the Valley. The final speaker was NEWSWEEK's editor for technology.

Three telecommunication modes were used: audio, computer and slow-scan video. The audio and video sessions were in real time; the computer conferences included both asynchronous and realtime sessions.

A couple of the interviews were audio only, but most employed freeze-frame video, enabling speakers and audiences to see as well as hear each other. The video helped to get speakers and students acquainted quickly. It also enabled the guest speakers to size-up their audience, so they had a better feeling about the level at which to aim their remarks. This made the speakers comfortable, and they promptly got down to business and made effective use of their time.

Along with these real-time interviews using freeze-frame and audio conferencing, a semester-long computer conference was set up especially for this class. Each week students typed questions onto computer terminals, from which they were relayed over the dial-up phone network to be stored on a mainframe in California. From there the questions were retrieved by a panel of specialists, who replied during the next few days over the same computer network, so the responses were awaiting the students at the next weekly meeting. At the final class of the semester, the remote specialists joined the students for a real-time discussion over the computer network.

The course provided two levels of training. It was the first actual experience with teleconferencing for most of the students. They received hands-on training in using teleconference equipment, and they became accustomed to interacting with a stranger who was thousands of miles away. In fact, this was training in public speaking, especially helpful for the many students of Asian or Polynesian background who normally talk very quietly and who are not accustomed to speaking in front of others.

On another level, the course provided preparation for living with, and working in, high technology. The students received practical, inside information on many aspects of the technology industry, including job hunting, and working and living conditions in Silicon Valley. A number of graduating seniors were considering working there, and felt that the course had given them better idea of what to expect.

In fact, as a result of the class, some were no longer so sure they wanted to go there. The guest speakers were quite frank, describing the negative as well as the positive sides of their work and even of their own personal life in the Valley. Their openness was probably encouraged by the interactive nature of the telecommunication. The speakers might not have been so candid if they had been unable to see and hear their distant audience.

Evaluations of the class were very favorable. The guest speakers appreciated the opportunity to discuss their work and their lives with interested, serious people, even though they were thousands of miles away. In fact, distance might have encouraged frankness, since there was little chance that a critical or controversial comment would find its way back across the Pacific to someone who might resent it.

Student enthusiasm for the class was indicated in several ways, including large enrollment, the high proportion of students from outside the department, and written evaluations. While other courses were being cancelled because of low enrollments, many more students applied for this class than could be admitted. A third of the class were computer science majors; it is unusual for students from "hard science" to take a sociology course, and for ten to enroll in an upper-division sociology seminar, despite bureaucratic barriers deliberately imposed by the instructor to weed out less-than-highly-motivated students, is rare indeed. Another third of the class were from other non-sociology departments, leaving only one third of the class to come from within the department. Anonymous evaluations by the students at the end of the semester rated the class as "the best" or "among the best" they had ever taken.

From my perspective as the instructor, I was pleased that these students developed more realistic ideas about high technology. Despite being thousands of miles away from major centers of technology, they gained insights, with the aid of their distant guest speakers, into one of the most pervasive forces in the world today.

* * * * *

The fact that these projects were conducted by one or two people, on a very low budget, should reassure prospective users that telecommunication need not be elaborate and enormously expensive.

his raises an important question. If teletraining is so effective, why isn't it used more widely?

The answer lies not in the technology but rather in the misconceptions of potential users. 'Telecommunications' implies, for many people, full-motion video, in color. But they know that this is very expensive; too expensive for them. So they dismiss telecommunications entirely, not realizing that there are other forms of it, most of which are far cheaper than full-motion TV—and for some purposes, just as effective.

This is unfortunate because lack of competent teachers is a perpetual problem in underdeveloped areas, and even in many parts of industrialized nations, including the United States. In fact, highly skilled instructors are in demand everywhere. Ironically, they are least willing to go to the very places which need them the most. The greater their skills, the less likely they are to leave their urban mileu to teach small groups in the hinterlands.

Teletraining offers a way of dealing with such problems. It is particularly appropriate in the Pacific, and in other regions where distances are vast, and audiences and budgets are small.

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* Equipment and computer conferencing services were provided by Colorado Video, Vidicom and InfoMedia.

Applications of Videotex in a University Environment

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1. Abstract

This paper describes the results of a course devoted to videotex technology which was offered to Bachelor of Science in Electrical Engineering (BSEE)-Telecom Option students at the University of Southwestern Louisiana (USL) during the Spring 1985 semester. The course represented one condition of a successful proposal to AT&T Corporation for a grant of videotex equipment. As a part of the course requirements, each student was assigned an individual term project to select a department on campus, either academic or administrative, and to explore possible videotex applications for that department. In addition to summarizing the results of the projects, the speaker will be showing a number of his students' slides demonstrating both the features of the FCS 500 Frame Creation System and Applications for videotex in a university environment.

2. INTRODUCTION

2.1 BACKGROUND

In August, 1982, the Electrical and Computer Engineering Department of the University of Southwestern Louisiana (USL) introduced a formal Telecommunications Option to its existing, nationally accredited, Bachelor of Science in Electrical Engineering degree program. This program is believed to be the only one of its type in the United States at this time. In just three years, the Telecom Option has grown to an enrollment of over 150 students. This phenomenal growth is partially attributed to the tremendous support and encouragement offered the program by the telecom industry. Both the International Communications Association, ICA, (the world's largest "telecom user" organization) and the Louisiana Telephone Association, LTA, (consisting of all of the common carriers operating in Louisiana), have been very supportive in terms of providing funds for scholarships, curriculum development and discretionary purposes. Many of their members have also been generous with their time, volunteering to serve on USL's INdustry Telecommunications Advisory Committee, INTAC. They serve as seminar speakers, provide industrial input on the curriculum and as contacts for possible equipment grants, scholarships and summer internships for telecom students.

2.2 AT&T PROPOSAL

As an example of INTAC's value, in the fall of 1984, one of the members alerted the speaker to the announcement of an AT&T Grants Program, which, in an effort to encourage new applications for videotex technology, donated videotex equipment to various universities throughout the country. Without this cooperation, USL would not have been able to respond to this call; with it, a proposal was submitted in time to meet the deadline. Fortunately, the proposal was successful and USL was awarded approximately $50,000 worth of videotex equipment. This included an FCS 500 Frame Creation System and 15 "sceptre" videotex terminals. At the same time, the University provided funds to purchase an AT&T Video Slide Maker and two enhancement software packages for the system.

3. COURSE PROJECT

3.1 STRUCTURE

One aspect of USL's proposal to the AT&T Grants Program was to devote a course, at least on a one-time basis, to a study of "Applications for Videotex in a University Environment." As outlined in the proposal, in the Spring, 1985 semester the 3-credit hour electrical engineering course, EECE 435, Telecom II, was devoted entirely to the study of videotex technology. Twenty senior students in the BSEE-Telecom Option were enrolled in the class. The textbook, Teletext and Videotex in the United States: Market Potential, Technology and Public Policy Issues by J. Tydeman, et al, was adopted for the course. It is a compilation of the findings of a study conducted in 1981 by a research team at the Institute for the Future with funding from the National Science Foundation.

The class met three times a week for fifty-minute sessions. For the first half of the semester, two sessions per week were devoted to lectures on the first ten chapters of the textbook. Topics included both current and future applications for videotex and teletext in the U.S. and abroad; technology forecasts for computer databases, communication networks and user terminals; and market potential and public policy issues. The third session per week was spent becoming familiar with the use of the FCS 500 Frame Creation System.

This was accomplished with an open lab scheme whereby the students could sign up times at their convenience, and thus, individually, learn to use the system.

After mid-semester, each student selected one department from a list of all departments on campus (including library, administrative and academic) as the subject of their individual term project. They then arranged an interview with a contact person within the department. In it, they explained the fundamentals of videotex and demonstrated some of its capabilities. Further discussions explored possible applications to the individual's department. Then, using the suggestions offered by the contact person, and his/her own ideas, each student wrote a report outlining potential applications for videotex which might lead to increased productivity or enhance the services offered by the department. As a part of their reports, each student was required to produce a set of demonstration frames generated in response to the interview process. During the last two weeks of the semester, the students presented their projects to the class.

One major problem developed in carrying out the project. It arose because of the extremely short time period between the delivery of the equipment (December 1984) and the beginning of the spring semester (January 1985). Because the FCS 500 system is designed to be utilized with a variety of different minicomputers and mainframes, the software necessary to accommodate the transfer of graphics data between it and the host computer (in USL's case, a Honeywell Multics 68-80) must be provided by the user. This could not be accomplished in time for the spring semester. Therefore, the students were unable to utilize the entire videotex system. That is, the frames generated by the FCS 500 must first be transferred to a database created in the host computer before they can be accessed via a sceptre terminal and a color television set; they cannot be accessed directly. Thus, the students were forced to utilize the FCS's capabilities independently by storing their frames on the 8" discs resident in the frame creation system itself. They were, however, able to create slides using the AT&T Video Slide Maker (which was received after mid-semester) for documentation purposes.

3.2 FINDINGS

The departments selected by the students were as follows:

Air Force ROTC

Electrical & Computer Engineering

Mass Communication

Marketing

Admissions

Economics

International Students' Office

Finance

Management

Physics

Departments Cont'd:

Food Services

Media Center

Library

Student Union

Conference Center

High School Relations

News Services

Placement Office

Athletics

Computer & Information Services

This certainly represents a cross-section of the various departments on campus, including about one-third academic departments and the rest administrative. In their reports, the students brought out a number of interesting applications. They also pointed to a number of weaknesses which will have to be overcome if the technology is to gain widespread acceptance in the years ahead. As expected, the reports represented a variety of viewpoints. Depending on the department, some students felt that color graphics was videotex's strong point, while others saw ASCII-based text as the most applicable.

Perhaps the best way to present a cross-section of the students' ideas is to provide a list of some of the specific applications they envisioned. These include:

1. Classroom presentations (all academic departments)
2. On-line registration and drop/add procedures
3. Operating instruction for specialized equipment
4. Recruiting
5. Campus information bulletins
6. Continuing education
7. Review of lecture material from missed classes
8. Dormitory message service
9. Campus news service
10. Access to library catalog information
11. Conference Center information on travel schedules, restaurant menus, meeting notices, etc.
12. Development of ROTC and band drilling formations and patterns

In the process of developing the above applications, a number of advantages and disadvantages of videotex became apparent. These may be summarized as follows:

Advantages of Videotex:

1. Can result in savings in printing, mailing and administrative costs when a hard copy is unnecessary;
2. Allows for continual updating of databases;
3. Ease of operation - programming skills unnecessary;
4. Can obtain as little or as much information on a subject as desired using various search techniques;
5. Ease in preparing professional-looking slides for presentations, etc.

Disadvantages of Videotex:

1. Low resolution graphics;
2. Difficult and expensive to obtain hard copy;
3. Inconvenient access to PCS 500 system when shared by a large user community;
4. Uncertainty regarding future regulation of videotex--how it will impact costs and transfer of information;
5. Only a limited amount of text provided on a frame (reduction makes it impossible to read).

2.3 CONCLUSION

In conclusion, videotex technology can be successfully employed in a university environment provided that a number of conditions are met. First, it is assumed that no regulatory decisions are forthcoming which would be detrimental to videotex as compared to competing technologies. Then, assuming that database access times are maintained at acceptable levels, the determining factor will be cost relative to other technologies such as computers, database services, message services, etc. It should be reported that it was the consensus of the students taking the class that at this time videotex offers no significant advantages over microcomputers which have already achieved far greater penetration within both the university and business. This is not to say, however, that this situation may not change drastically within the next ten years depending on technological improvements and telecommunications policy decisions.

OPEN SKIES, GRASS ROOTS

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ABSTRACT

The Knowledge Network is a learning system which has recognized the "grass roots" community-level development that is necessary to complement the "open skies" approach of its satellite delivered public telecommunications service as a means to order the above problem. This development includes the emergence of many levels of network beyond the technical provision of signal transference. In particular, there is the emergence of a Learning Centre Network to provide community-based centres for learning and training that will use computer and video based courseware as well as being linked together by the satellite service of the Knowledge Network. The Learning Centre Network represents a powerful new model that integrates the new human and social opportunities made possible by technology within a framework of adult education.

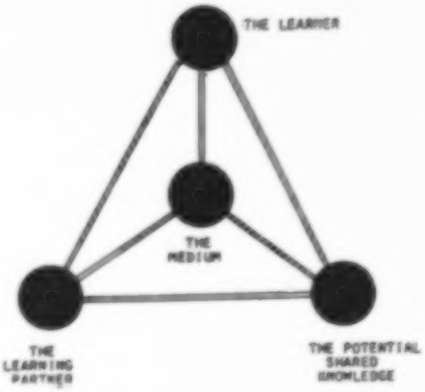
1.0 Since 1980, the Knowledge Network has operated a sophisticated architecture of technological and organizational networks that has begun to change concepts of learning and has demonstrated an integrating methodology for the use of new technology by existing agencies. The success of the "little network that could" has been astounding and has shown that technology in and of itself is not the issue. However, when technology is considered as an agent in the interactions of learning, then it provides us with a catalyst for reconceiving the total educational enterprise.

1.1 From its inception as a satellite-based telecommunication network, the Knowledge Network has been innovative, questioning assumptions about media, technology and learning itself. Some of the questions asked have led to new perspectives on teaching and learning; questions such as:

- What is the true nature of interaction in the teaching/learning process?
- What is the criteria of effectiveness of media used in teaching/learning?
- How can we design systems that lead to experiences that evoke the interactions that will lead to learning?
- What is the nature of the interface between the use of technology and the environment of the learner?

1.2 These questions all derive from thinking about learning and the use of technology from the perspective of the learner. Not only is the theoretical base learner-centred but it is also concerned with the interactions and fundamental relationship necessary to evoke learning. These can be described in the framework of the Learning System (Forsythe, 1985).

DIAGRAM 1



The concern of this paper is to deal with the particular perspective of the environment of the learner and, in particular, the creation of a Learning Centre Network.

2.0 For the past century, the campus has traditionally provided an environment for learning, one whose raison d'etre was the pursuit of knowledge. Open learning systems, with the use of new technology, expanded that environment back to the home and to the workplace, the historic venues of learning and training. However, both of these environments have also shifted and are no longer always conducive for learning as previously they may have been.

"A good environmental image gives its possessor an important sense of emotional security."
(Norberg-Schulz, 1980)

All cultures have developed systems of orientation, that is, "spatial structures which facilitate the development of a good environmental image." The world may be organized around a set of focal points, or be broken into named regions or be linked by remembered pathways. The new information technologies provide a means to do all three. The key, however, is providing a locus for all the new uses of technologies, a half-way house for the new notion of learning in society, made possible by new technologies. This could be the role of the learning centre. Where possible, people could still choose to go to campus, or choose to learn entirely in their own home. If the gulf between these two extremes is not to widen, with the danger that the campus becomes an anachronism and a closed box in an environment alive with electronic networks, then a middle place must be found. That place must provide not only the spatial orientation necessary to make concrete these invisible networks but also the identification with a new kind of environment, a place where instructor and student alike can feel safe learning, because the new technologies make learners of us all.

2.1 Human identity presupposes the identity of place and identification is the basis for our sense of belonging. For this reason we would be wise to consider this intermediary place, the creation of the environmental image for learning, the learning centre, where the vocation of the place is open to the environment both locally and globally through its telecommunications links, and its philosophy of providing resources at the convenience of the learner.

2.2 The use of the word "learning centre" is commonly used to refer to places where resources are provided for individualized learning. The difference is that direct instruction by teacher to groups is not the norm in the learning centre. Usually instruction is individualized through the use of resources; human and multimedia, including television and computer. Since the development of "networks" the learning centre has also become a "node" or communications link into a larger system. Because learning also implies inter-action, learning centres have become a focus for interaction. (Salomon, 1982)

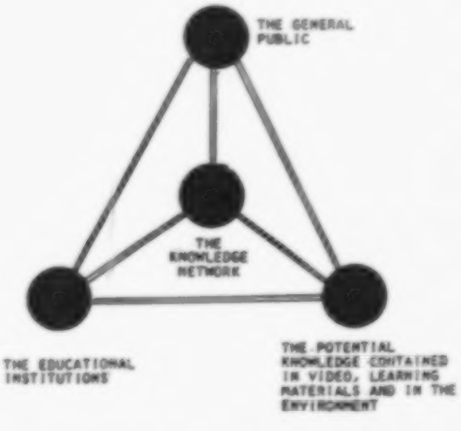
2.3 Are the campus model and the learning centre model incompatible? Are they aspects of a learning continuum? How are they the same? How are they different?

The key ideas here seem to relate to the method of instruction. New technologies present new human opportunities for learning. With television and computer we can show, tell and interact in ways we previously could not. This does not, however, eliminate the need for human interaction. It may, however, alter the roles of the human instructional agent and the environments for the new interaction. It is, indeed, conceivable that the integrating philosophy of open learning and the development of more sophisticated applications of technology in learning may well assist the traditional educational environment to reconceive its underlying structure and "The University will grow smaller as it grows larger and the university will be everywhere and the campus nowhere." (Thompson, 1977). The Learning Centre, then, may function as a half-way point to this more widespread change.

3.0 As well as the human need for identification in the environment, the Learning Centre Network addresses another fundamental notion of learning - interaction. In the new learning theories, such as Conversation Theory, (Pask et al, 1975,76) learning occurs through the phenomena of the conversation. Conversation is the point where at least two participants or perspectives come together to assert a distinction as well as a similarity relation between them. (Pask, 1980). Thus learning is considered an interactive dialogue that is fundamentally creative (Forsythe, Haughey, 1985).

3.1 Such a view forces us to ask the question How do we design systems to evoke conversation? Satellite technology has presented the potential for conversation from point to multipoint as well as through networks. The direct interaction of conversations can occur through audio-teleconferencing, video or computer conferencing. There are, however, practical limits on the potential for meaningful conversations, mediated by technology. These technologies, however, can also be used as organizing frameworks and agents to cause group interaction at the local level - facilitating both inter and intra group conversations. However, to make both systems work, equal attention has to be given to the environment of the group as to the design of the program substance and the use of technology.

DIAGRAM 2


THE GENERAL PUBLIC
THE KNOWLEDGE NETWORK
THE EDUCATIONAL INSTITUTIONS
THE POTENTIAL KNOWLEDGE CONTAINED IN VIDEO, LEARNING MATERIALS AND IN THE ENVIRONMENT

THE INTEGRATION OF SATELLITE-TELE-EDUCATION WITHIN THE EDUCATIONAL SYSTEM

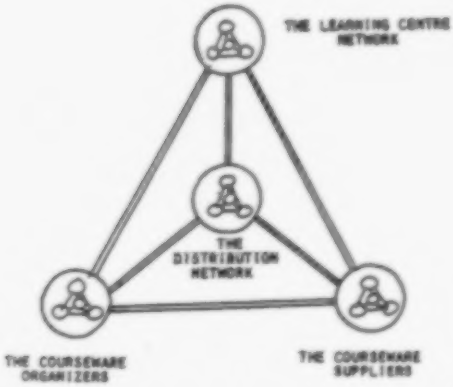
4.0 When it was conceived in 1980, the Knowledge Network endeavoured to deal with both the input and the output of its satellite telecommunications system. Although its service, carried on Canada's Anik C satellites since 1982, was retransmitted by cable television to 85% of B.C.'s homes, an embryonic learning centre network was also established by the Regional Colleges in British Columbia.

4.1 The economic environment over the past three years has made it increasingly difficult to maintain these centres as originally conceived as adjuncts to the traditional system. Conversely, the success of the Knowledge Network in demonstrating the effectiveness of the satellite-based learning system for education and training continues to put existing pressure on the Network's 14 hour a day schedule.

4.2 In 1984, planning began to reconceive the notion of a Learning Centre Network. Currently, the Knowledge Network has developed a plan which would involve the development of such a network, electronically linked by satellite, focussing primarily on employment training and retraining, and professional education. This would mean two parallel but complementary telecommunications services, one open to the public in their home, one closed circuit to learning centres.

4.3 However the Learning Centre would also serve as a focal point for use of interactive video disc, CAL, audio-conferencing, video-conferencing, as well as providing local input of needs to a centrally coordinated system. The use of technologies that could draw response from many agencies would enable such a system to provide enormous variety of opportunity to small scattered populations and still provide human mediation and environmental identity.

DIAGRAM 3



THE LEARNING SYSTEM AND A LEARNING CENTRE NETWORK

4.4 The key, however, lies in the organizing principle of cooperative individuality which at one time acknowledges the autonomy and uniqueness of individual learners, institutions and agencies, and yet also finds the common ground of our shared knowledge and shared mandate and orders our relationships towards the common goal - learning.

5.0 If we review the issues we find that, irrespective of electronic networks to provide ready access to information directly in the home or workplace, a number of human factors suggest that a "locus" or centre will still be necessary if successful integration and use of the new technology is to be achieved.

5.1.1 HUMAN IDENTITY PRESUPPOSES THE IDENTITY OF PLACE.

Emotional security is often derived from a good environmental image. In order to learn effectively at home or on the job, it is well-known that a consistent place and time for learning must be found. The creation of a "learning centre" provides the environmental image, the "vocation" of place that identifies "learning" in the environment as surely as "school" or "campus". The difference is that the methodologies of the learning centre are based on the use of new information technologies and different forms of human interaction.

5.1.2 NEW THEORIES OF LEARNING SUGGEST THE NEED FOR HUMAN INTERACTION IN THE LEARNING PROCESS

New information technologies allow us to provide for human interaction in both direct and indirect ways. The existence of a Learning Centre provides an environmental focus for interaction that is social as well as tutorial. It may also be the focus for interaction that is attenuated by distance such as a video or audio conference. Although these can be accommodated in the home or workplace, a controlled environment designed to facilitate such interaction will probably have more predictable outcomes.

5.1.3 ADULT ATTITUDES TOWARDS CHANGE AND NEW INFORMATION TECHNOLOGIES

The integration of new information technologies designed for learning and training pose many new questions not the least of which is the fear and uncertainty that many adults face in beginning to use the new technologies. Although children and young people seem to readily accept the new devices, a significant proportion of the adult population are in need of "half-way" houses where they may go to learn to use and experience new technologies in a climate of support.

5.2 As well as these three human factors, a number of characteristics of the Canadian geographic and social organization also support the idea of a Learning Centre Network.

5.2.1 SMALL POPULATIONS OFTEN SCATTERED OVER GREAT DISTANCES

Most communities in Canada are too small to support a diverse range of conventional adult training and education programs. There are never enough people to support either the facility and equipment or even a particular class.

Use of satellite telecommunications combined with a Learning Centre Network allows the creation of an "electronic classroom" where participants may be aggregated over a number of communities. The facility to provide an inventory of free-standing learning and training modules using new information technologies, that may be available through the Learning Centre Network, also increases the ability to respond to individual and discrete needs in a manner not feasible before.

5.2.2 RAPIDLY CHANGING TRAINING NEEDS WITH SMALL TARGET POPULATIONS, OFTEN DISPERSED.

Again, the Learning Centre Network provides a mechanism to react quickly to needs that have not been sufficiently articulated for institutions and other training agencies to develop responses but are in demand by the marketplace. As such, the Learning Centre Network can provide a leading edge, needs assessment function through innovation.

5.2.3 DUPLICATION OF EFFORT IN THE DEVELOPMENT OF TRAINING MATERIALS, NO ORGANIZATIONAL FRAMEWORK FOR SELECTION AND INTEGRATION OF PROPRIETARY TRAINING PRODUCTS.

The development and marketing of training materials is a burgeoning industry in North America. The Learning Centre Network would provide assistance in matching available resources to needs for specific companies as well as for individuals. For example, an in-house training program may be possible based on 70% available resources and only 30% internal development.

5.3 The key features of the Learning Centre Network are:

5.3.1 Flexible systems that respond to human needs.
5.3.2 Community or industry based systems.
5.3.3 Aggregation of learning and training in one focal centre.
5.3.4 Aggregation of diverse needs through the electronic classroom.
5.3.5 Reduction of duplication of effort.
5.3.6 Organizational framework dedicated to matching needs and resources in effective, systemic ways that are perceived to be human-scale by the learners as perceived to be relevant by employees.
5.3.7 Identification of new or emergent needs.
5.3.8 Focal point for aggregation of specialized or expensive equipment such as interactive laser-video disc equipment.
5.3.9 Focal point for access to immediate sources of training and information through video conferencing, etc.
5.3.10 Enables local community and/or industry to be an active participant in operating the learning centre at the local level.

6.0 This is realized for people as in the following hypothetical scenarios:

6.1.1 In Kitimat, Company X, the main employer, recognized the need to provide opportunities for employees to expand their knowledge and ability to handle technological change. Although there was still a benefit to having key people travel to training sessions or in bringing in special trainers, the company recognized the long term benefit in encouraging on-going employee learning. The question was how to meet the diverse needs and how to incorporate this as an ongoing aspect of the work environment and culture. Through the Learning Centre Network, the Company was able to establish a small learning centre which was open to employees and which enabled high quality individualized courses to be made available as they were necessary. A spin-off for the Company was the access to many other learning opportunities for employees and their families.

6.1.2 In Sooke, May and John Smith, both former teachers, decided to join the Learning Centre Network as full members. They rented a shop in the mall and began to operate "The Sooke Learning Centre", providing a full range of educational and training opportunities. Operating like a franchisee, the Smiths were responsible for attracting their clients and providing service to meet their needs. This meant that they had to stress quality of learning, that their role in business was to ensure that the client learned what s/he wanted to learn. Being associated with the Learning Centre Network meant that they had full access to courses and programs from many institutions and agencies, and their rigorous training in tutoring and learning meant that the many agencies and institutions such as the Open University Consortium of British Columbia, who contracted with the Learning Centre Network for services, had confidence and respect for the assistance their students could expect from the Learning Centre Network.

6.1.3 As Paul Jones locked the school door, he smiled to himself - midnight and the last person had just left. One couldn't complain about under-use of facilities these days! This school really had become the learning centre for the community - its six rooms provided not only schooling for all the school age children but, since joining the Learning Centre Network, all kinds of training opportunities and education for the adults as well. Ever since they had volunteered to participate in the Schools Network three years ago, things had begun to change. The tiny, remote school must be one of the most sophisticated electronically equipped facilities anywhere but they hadn't lost the human touch. In fact, people seemed to feel much better about things since they could control what they wanted to learn and since they could come here when they needed to - for a quiet place to study, to find someone to talk to, or to use the facilities. And look at me, I'm finally finishing my Masters degree. Who would have believed this was possible back in 1980?

6.2 In these scenarios, the focus is the learning centre - the networks that enable such responsiveness are invisible to the learner. However, the service is still personal and individual and can draw on resources no matter where they may be because distance no longer becomes the issue - appropriate connection for interaction becomes the guiding purpose.

7.0 The biggest issue facing education today is the problem of integrating media and technology. Dealing with these issues forces us to reconceive our notions of learning as well as the industrial model of education. The ideas and prototypes being developed in B.C. although technologically driven, are enabling and requiring re-conceptualization of the educational enterprise by providing an integrating methodology and philosophy that works at the individual and organizational level. We hope that the development of the prototypical Learning Centre Network will provide insight and experience for others who wish to deal with the difficulty of training and re-training adults who cannot be dislocated from their homes or physically aggregated in one place.

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Q-NET: Proposed Experiments, with particular emphasis on educational applications

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Abstract

In August and October, 1985, Australia received access to its first two domestic communication satellites being launched by the Space Shuttle. The State of Queensland has leased one 12 watt transponder on AUSSAT 1 for the purpose of establishing a comprehensive telecommunications network, 'Q-NET'. A number of government departments have proposed a variety of experimental projects for the pilot phases (1985-87) of the system. This paper describes Q-NET and, in particular, the educational trials.

1. QUEENSLAND IN CONTEXT

The advantages of satellite communications increase with the size of the area to be served and the traffic to be carried. Australia is, therefore, ideally suited to benefit from such a service. Australia has about the same area as the United States of America, but has only 15 million people, located mainly in the south east corner and around the coast.

Queensland covers 1,727,000 square kilometres and there is substantial activity in virtually every corner of the State. Communication services, including roads, however, are still only minimal in some very remote areas, and are problematic at certain times of the year.

Queensland is unique in its distribution of population. Of the 2,471,600 people (1983 est.) only about 30 per cent live in the capital city, Brisbane, and about 39 per cent live in centres under 10,000.

In a May 1984 report of the Australian Department of Communications, 'Regional commercial television services for remote communities and isolated properties', it is stated that in Queensland 71,700 people do not receive even the ABC (Australian Broadcasting Commission) television services and, in 1981, 163,650 people did not receive any commercial service. About one quarter of them are children.

2. Q-NET: The Queensland Telecommunications Network

The Queensland State government has decided to establish a comprehensive telecommunications network mainly for the use of its public service systems. That is, all government and semi-government departments and institutions will be able to use this network.

The system will be a hybrid of terrestrial and space components incorporating Telecom STD, Telecom leased lines, Queensland government terrestrial systems and AUSSAT satellite transponders and earth stations. The whole system will be under the administration of the Department of Commercial and Industrial Development (DCID).

During 1985, the major project, involving outside consultants, is the development of a 10-year Strategic Plan for the full development of Q-NET (Attachment A).

The second project underway is the Pilot Network which received Cabinet approval on 5th November, 1984, and an allocation of $7 million, mainly for the space segment, particularly a network of earth stations. The Pilot Network has two stages: Phase 1, 1985-86, will cost $3 million, and Phase 2, 1986-87, $4 million. Funds are for the purchases, installation and maintenance of the earth stations.

The Queensland government has leased a 12-watt transponder, or the equivalent, on AUSSAT 1 to be launched on 11th August, 1985, and this became operational in October.

3. THE PILOT NETWORK: PHASE 1 (1985-86)

3.1 THE TECHNOLOGY

With regard to the technical aspects of the Network, tenders have been let to NEC for following earth stations:

1 x 40 channel (capital city)
4 x 10 channel (Provincial centres)
15 x 1 channel (Remote communities)
20 x TV Receive only (TRVO)
1 x transportable

These will be established progressively from September, 1985, to June, 1986, in the centres listed in Attachment B and set out in Attachment C.

As yet no specific sites have been determined, but responsibility for siting the TVRO's has been given to the Education Department. These will be sited in schools, education/teacher centres and tertiary study centres by the middle of November, 1985.

Nor is it known what electronics will be provided at each centre, but these will include loud-speaking telephones, microcomputers with modems and attachments, television receivers, video-cassette recorders, AM and FM radio receivers and Slow Scan Television units.

The capacity of the system will depend on the types of equipment provided. Interactive voice and data will be the heaviest use. One way video, up-linked from Brisbane only, and two-way audio/data will be possible. The public servants of the 'Government Departments and Instrumentalities' will use the system fully between 9am and 5pm each weekday, except for a possible lull in traffic between 12 and 2pm.

3.2 THE PROJECTS

A total of more than 20 significant trial projects involving seven Departments and Instrumentalities have been approved by Cabinet for Phase 1 (Attachment D). Many of these 'projects' have subsets of several programs. A list of projects is given in Attachment E. They include Health, Railways, Electricity Commission, Police, Water Resources Commission, the Government Computer Centre, Primary Industries and Education. The Health Department has five projects well on the way into detailed planning. These are summarized as follows:

- the North-west Telemedicine Project
- the Orthodontic Project
- the Family Medicine Programme
- Hospital Administration
- Nursing.

The North-West Telemedicine Project

This project is designed to examine the performance of a telemedicine service using slowscan TV to transmit x-rays and ultrasound pictures from peripheral units to Mt. Isa and Brisbane. Facsimile and two-way voice will also be used to serve the following functions:

- emergency medical consultation, involving medical personnel at Mornington Island, Normanton, Burketown and Doomadgee; and at the R.B.H. complex for telemedicine consultation with Mt.Isa, and with the peripheral units after screening by Mt. Isa.
- ward round type conferences, involving routine medical consultation at a distance.
- off peak records transmission; including admission and discharge information.

The Orthodontic Project

The Orthodontic Project will enable consultation and case discussion between field dental officers and an orthodontist stationed in Brisbane. It will involve the transmission of information by clinical and photographic records, x-ray and models.

The Family Medicine Programme

This project will allow the extension of family medicine programmes to doctors training for general practice in many centres in Queensland.

Hospital Administration Project

This project will provide a videotext service for frequently used information such as the M.O.P.s. This information will be accessed by all public Hospitals Boards in Queensland via either Q-NET or the Public Switched Telephone Network.

The Nursing Proposal

This project is to provide continuing education for nurses and will enable nurses to keep up to date with changes and advances in nursing practice and maintain or develop skills to carry out specific roles without having to leave their local area.

With regard to Education, there are five main areas of application:

Mt. Isa School of the Air

This is a $1.5 million project involving a class of eight Year 6 students in remote areas in North Queensland. About 2 hours a day of interactive audio and microcomputers mainly from Mt. Isa, and a half-hour of live video from Brisbane each week for 1986 will test the system for this type of application.

Early Literacy Inservice Course (ELIC)

The Queensland implementation of the national project, ELIC, will use both terrestrial and space systems. The course will involve a network of local facilitators and about 400 teachers.

State Film Library

A selection of films and videos will be transmitted to all centres for recording and use in schools in the area.

Technical and Further Education

Details of this proposal are not yet available.

Higher Education

These proposals are discussed in the following section.

4. HIGHER EDUCATION

4.1 INVOLVEMENT

Five of the ten higher education institutions are prepared to be involved in Phase 1:

Brisbane C.A.E.
Capricornia I.A.E. (Rockhampton)
Darling Downs I.A.E. (Toowoomba)
James Cook University (Townsville)
University of Queensland (Brisbane)

These institutions already share a State-wide network of study centres. It is expected that permanent lines or earth stations will be installed for these institutions for the two-year period of the Pilot Network, during which all transmission time will be free of charge.

If adequate bridging facilities are provided, it will be possible for these five institutions to use electronic mail and audio-teleconferencing for a range of administrative and educational purposes.

4.2 PROGRAM PROPOSALS

Detailed work on the program proposals is underway and Brisbane C.A.E. programs are given as examples in the following sections. Other institutions have proposed programs as follows:

Capricornia I.A.E.

(a) Screen to screen (video) communication using the Aregon system between Rockhampton and Gladstone for teaching Business, Mathematics and Science subjects.

(b) Computer assisted learning to teach programming languages.

(c) Audio-teleconferencing with groups of centres for teaching a range of external subjects.

Darling Downs I.A.E.

Building on extensive experience during the past few years, DDIAE proposes up to 10 hours per week, in the evenings, of tele-tutorials for external students in a wide range of subjects in over 15 study centres.

James Cook University

(a) Computer links with CSIRO and the University of Queensland will be tested.

(b) Contact, especially interactive audio, with external students.

(c) Data transfer, especially for administration and library purposes.

University of Queensland

(a) 'Small Animals', a continuing education course of ten one-hour audio-teleconferencing sessions, by the Veterinary Science Post-graduate Committee.

(b) The Library will test facsimile transmission and professional development projects.

(c) 'Psychomotor Therapy', a continuing education course of ten one-hour audio-teleconference sessions mounted by the Department of Occupational Therapy.

(d) The Continuing Education Unit in collaboration with 4ZZZ will acquire educational radio programs through the Public Broadcasting Association of Australia for transmission during evening hours.

(e) Audio-tutorials are proposed for a range of award courses.

(f) Continuing professional education short courses are proposed for Dentists and for members of the Australian Institute of Medical Laboratory Scientists.

4.3 BRISBANE C.A.E. PROPOSALS

Following is a summary of the programs proposed by BCAE for Phase 1.

Proposal A: 'Once-Fired Pottery with Carl McConnell'

A series of nine videotaped programs of 30 minutes each produced jointly with the Australian Flying Arts School, this will be transmitted via satellite to centres in April - June, 1986, and repeated in late - 1986 with live segments involving Carl McConnell with the capacity for remote participants to interact by audio teleconferencing.

Proposal B: 'Music and Education'

Two series of FM Radio broadcasts totalling seven hours produced in collaboration with 4MBS in 1984 will be re-broadcast via satellite. These are'The Nature of Music' (Dr. Stuart Collins) and 'Educators and Their Music' (Keith Smith, Claire McCreath, Merrill Desbki).

Proposal C: 'Basic Maths in the Primary School'

A series of eight continuing education programs are planned - four for Phase 1 on 'numeration' and a repeat of these plus four more on 'operations' for Phase 2 (1986-87). Dr. Cal Irons (Carseldine) and a team, including a lecturer from McAuley College, will produce videotapes and print materials to be sent out in advance. Then groups at a number of centres will be linked via audio-teleconference by satellite and terrestrial systems. This will be for teachers and parents.

Proposal D: 'Reading and Children's Literature'

This will be series of four continuing education programs on learning to read, reading to learn, skills-based reading schemes and literature in the curriculum. Dr. Brendan Bartlett (Mount Gravatt) will head a production team to include a lecturer from McAuley College as well. These programs will be organised in a similar pattern to the ones in 'Proposal C'.

Proposal E: 'Current Education Video Magazine'

This project will involve, initially, five one-hour live programs of video with interactive audio. Each program will feature one or more senior educational administrators, government representatives, visiting and local academics, discussing the various educational issues which have been identified as of interest or concern to Queensland.

Proposal F: 'Training Packages for Q-NET Users'

Building on the expertise and workshops on teleconferencing already offered by the College, a set of training packages will be produced in the form of modules which may be used either separately or in various combinations. These may be used in in-house group workshops or with dispersed groups through the actual use of the telecommunications technology. The modules will ultimately include the following topics:

How do satellites work?
Audio-teleconferencing techniques
Telemeetings
Tele-education
Teletraining (for business)
Human factors in telecommunications
Audio-graphics (especially SSTV)
Electronic mail
Microcomputers in telecommunications
Video-teleconferencing

If the State government appoints a Key Centre Operator for each earth station then these modules may be used for their basic training.

To give some indication of the in-depth planning, details of Proposal C: Basic Maths in the Primary School are given here:

(1) Title: Basic Maths in the Primary School

(2) Intended clientele: Pre-school and primary teachers and parents.

(3) Resource people and presenters:

Dr. Cal Irons, Head, Department of Maths, Science and Computing, Carseldine Campus - Project Leader

Ms Rosemary Irons, Lecturer, Care and Education Department, Kelvin Grove Campus

Dr. Tom Cooper, Lecturer, Department of Maths, Science and Computing, Carseldine Campus

Mr. John Kaminski, Lecturer, McAuley College.

(4) Brief Synopsis: The College is well known for its Centre for Mathematics, its Masters Degree in Primary Mathematics, and publications in the field.

Furthermore, during 1980-85 a number of continuing education workshops on mathematics have been successfully implemented in the Brisbane area by the resource people. It is planned that these workshops can be adapted for delivery to the centres in Q-NET.

The aims of this series are, firstly to explain and review basic and new aspects of teaching numeration in primary school mathematics, and, secondly, to take advantage of the satellite-based telecommunications system, Q-NET, being established by the Queensland government.

Specifically, the objectives are to provide participants with:

- a sequence for developing numeration across the primary school.
- demonstrations of strategies and materials for teaching numeration in the primary school.
- the opportunity to discuss the teaching and learning of these concepts with each other and with specialists in the field.
- the opportunity to learn skills associated with distance communication as provided by Q-NET.

(5) Duration/Mode/Structure:

(a) There will be four videotapes each approximately 30 minutes, produced to relate to the four programs in this series. The videotapes will be transmitted via satellite in down-time, late at night, to be recorded by the centres. A back-up service will be given for copied videotapes to be sent to centres which for some reason fail in the recording off the satellite.

Print materials will be sent to each registered individual in advance.

(b) The four programs will be presented on Thursday evenings to the interactive satellite centres. Each program will involve a three hour commitment. During the first 90 minutes participating groups will view a videotape and engage in preliminary discussion. The next 60 minutes will involve an interactive audio-teleconference linking centres with each other and with the resource people in Brisbane. The final half hour will involve further local group discussion and evaluation.

For those centres with TVRO units, alternative times will be made for a Telecom link-up.

(c) To enable sufficient interaction to occur, centres have been divided into groups as follows:

Satellite Group A:	Cairns Mt. Isa Thursday Island Townsville Doomadgee Rockhampton Toowoomba Burketown

Normanton
Mornington Island
Emerald
Longreach
Cunnamulla

Telecom Group B: Mackay
Bundaberg
Maryborough
Dalby
Warwick
Charleville
Atherton
Ingham

Telecom Group C: Bowen
Hughenden
Chinchilla
Moranbah
Gladstone
Murgon
Gold Coast
Edward River
Wujal Wujal

(d) For the satellite group the programs will be presented on Thursday evenings as follows:

Satellite Group A: 5:00-8:00p.m.
(Link-up 6:30 - 7:30 p.m.)

10th April, 1986: Beginning mathematical thinking with numbers.

17th April, 1986: Establishing the numeration system with two-diget numbers.

24th April, 1986: Extending numeration to larger whole numbers.

1st May, 1986: Expanding numeration to decimal fractions

The four resource people will each 'chair' an evening.

(e) Participants will be asked to register and a fee of $30.00 will be charged for the series.

Each one will receive a study guide and a comprehensive book on numeration.

(6) Evaluation will be by feedback questionnaire and by questioning at the end of each program.

NOTE: It is intended to repeat these four programs in Phase 2, and to add four more on 'operations'.

(7) Equipment requirements:

(a) Transmission - video
loudspeaker telephone
facsimile unit

(b) Reception - video recorder
TV receiver
loudspeaking telephone
overhead projector
facsimile unit

5. PHASE 2, AND BEYOND

Planning is already underway for Phase 2, 1986-87, to extend the network of earth stations and upgrade the Phase 1 centres. Also, all government agencies departments and educational institutions have been invited to submit further project proposals.

At this stage it appears there is no shortage of ideas. The two major problems arising are:

(a) lack of expertise in this type of communications system, and

(b) inadequate funds to produce good quality programs with something other than 'volunteers'. Most projects, in higher education at least, will have to be done over and above 'normal duties'.

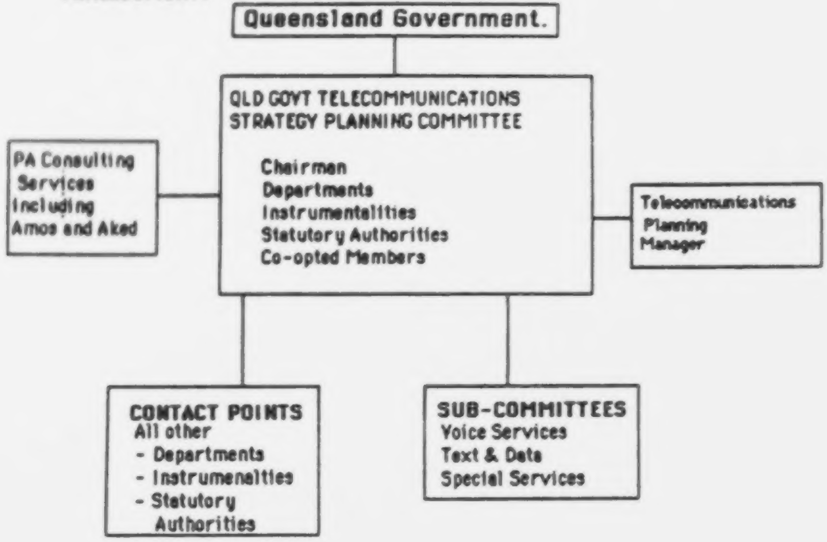
It will be interesting to see exactly how the proposed programs attempt to exploit the new technology. That is, if the satellite is only going to become a substitute for the telephone then this is not worth the huge expense. The new system will have to provide new kinds of services and experiences.

The key will be the creative strategies developed by educators. That is, the special attributes of the new system will have to be exploited to enhance participation and interaction on the part of students and teachers.

ATTACHMENT A

STRATEGY PLAN.

MANAGEMENT.


Queensland Government.
QLD GOVT TELECOMMUNICATIONS STRATEGY PLANNING COMMITTEE
Chairman
Departments
Instrumentalities
Statutory Authorities
Co-opted Members
PA Consulting Services including Amos and Aked
Telecommunications Planning Manager
CONTACT POINTS
All other
- Departments
- Instrumenalties
- Statutory Authorities
SUB-COMMITTEES
Voice Services
Text & Data
Special Services

ATTACHMENT B

Q-NET (PILOT DESIGN)
EARTH STATION ALLOCATION (PHASE 1)

Major City Earth Station	M1	Aussat Rochedale (used for TV uplink only)
Capital City Earth Station	C1	* Brisbane Mineral House
Provincial City Earth Station	P1	* Cairns
	P2	* Mt. Isa
	P3	* Thursday Island
	P4	* Townsville
Remote Community Earth Station	R1	* Kowanyama
	R2	* Doomadgee
	R3	* Lockhardt
	R4	Rockhampton
	R5	Toowoomba
	R6	Burketown
	R7	Normanton
	R8	Mornington Island
	R9	* Emerald
	R10	* Longreach
	R11	* Cunnamulla
	R12	Torrens Creek (Rail)
	R13	Homestead (Rail)
	R14	Goondiwindi (Rail)
	R15	Burdekin (Q.W.R.C.)
T.V. Receiver Only	T1	Mackay
	T2	Bundaberg
	T3	Maryborough
	T4	Dalby
	T5	Roma
	T6	Warwick
	T7	Charleville
	T8	Atherton
	T9	Ingham
	T10	Bowen
	T11	Hughenden
	T12	Chinchilla
	T13	Moranbah
	T14	Gladstone
	T15	Murgon
	T16	Gold Coast
	T17	
	T18	
	T19	Edward River
	T20	Wujal Wujal
Transportable	X1	Various

* Also capable of connection to "Q-NET" switched network.

ATTACHMENT C

EARTH STATION IMPLEMENTATION TIMETABLE.

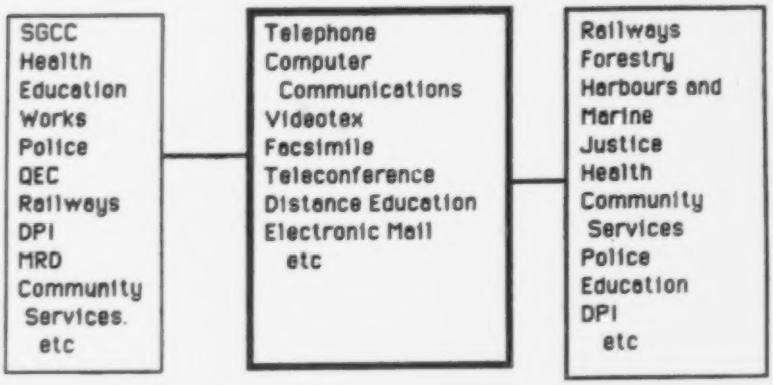
```
1985                          1985 1986                     1986
 J .  J .  A .  S .  O .  N .  D .  J .  F .  M .  A .  M .  J

Brisbane (1&2) _ _ _ _

        Mt. Isa (1)

   _ _ D'gee  (2)

        _ Mornington Is

             _ _ _ Burketown (1)

             _ _ _ Normanton (2)

                 _ _ _ Thurs. Is. (1)

                 _ _ _ Emerald (2)

                   _ _ _ Cunnamulla (2)

                      _ _ _ Rockhampton (1)

                        _ _ _ Burdekin (1)

                        _ _ _ Toowoomba (2)

                            _ _ _ Longreach (2)

                                 _ _ _ Townsville (1)

                                 _ _ _ Homestead (2)

                                     _ _ _ Torrens Creek (2)

                                     _ _ _ Cairns (1)

                                          _ _ _ Lockhart (2)

                                          _ _ _ Kowanyama (2)

                                          _ _ _ Goondiwindi (2)
```

Notes

1. Two installation teams (1) and (2)
2. Solid lines indicate nominal period during which teams will be working on site: some site preparation work will be required earlier.
3. TVRO installation not included.

ATTACHMENT D

Q-NET USERS AND SERVICES.

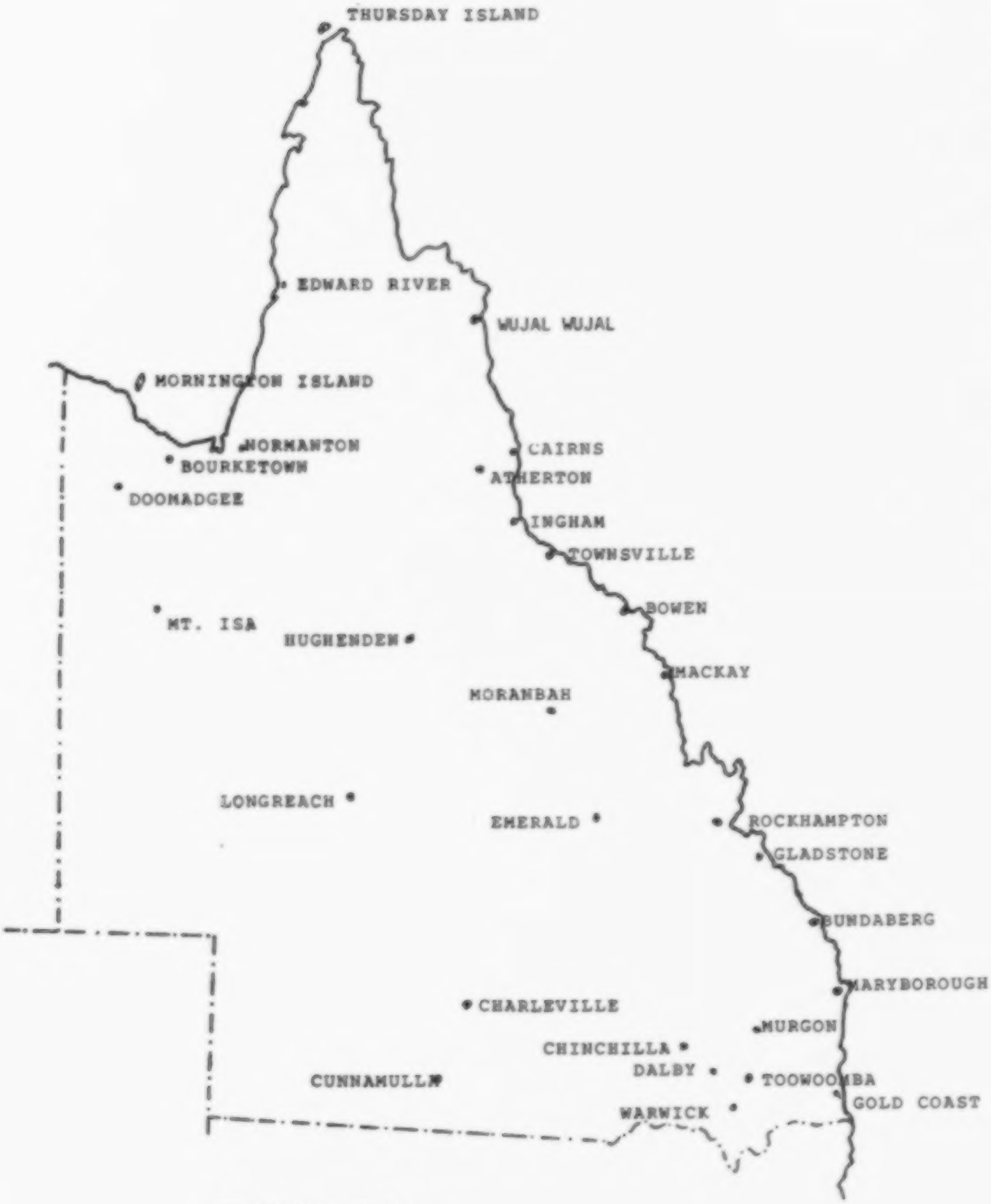

SGCC
Health
Education
Works
Police
QEC
Railways
DPI
MRD
Community Services.
etc
Telephone
Computer Communications
Videotex
Facsimile
Teleconference
Distance Education
Electronic Mail
etc
Railways
Forestry
Harbours and Marine
Justice
Health
Community Services
Police
Education
DPI
etc

ATTACHMENT E

Q-NET (PILOT DESIGN)

PROJECT SUMMARY

Project 1	North West Telemedicine Project
Project 2	Orthodontal Project
Project 3	Family Medicine Programme
Project 4	Deferred for consideration in Phase 2
Project 5	
Project 6	Hospital Administration (MOP) - Videotex
Project 7	Nursing Studies
Project 8	Railways - VHF Mobile
Project 9	Railways - Signalling
Project 10	Queensland Electricity Commission - Townsville AVD
Project 11	Police Wideband link - POC
Project 12	Thursday Island Police - PCMSS
Project 13	Mt Isa Police - Burketown
Project 14	Transportable
Project 15	Queensland Water Resources Commission - River Monitor
Project 16	Queensland Water Resources Commission - Burdekin Dam
Project 17	State Government Computer Centre - High Speed D
Project 18	Vacant
Project 19	Education Department - ELIC
Project 20	TAFE
Project 21	BCAE
Project 22	University of Queensland
Project 23	CAE
Project 24	James Cook University
Project 25	Reserved DPI
Project 50	Mt Isa School of the Air (SOTA)
Project 100	Q-Net (Switched Network)


THURSDAY ISLAND
EDWARD RIVER
WUJAL WUJAL
MORNINGTON ISLAND
NORMANTON
BOURKETOWN
DOOMADGEE
CAIRNS
ATHERTON
INGHAM
TOWNSVILLE
BOWEN
MT. ISA
HUGHENDEN
MACKAY
MORANBAH
LONGREACH
EMERALD
ROCKHAMPTON
GLADSTONE
BUNDABERG
MARYBOROUGH
CHARLEVILLE
MURGON
CHINCHILLA
DALBY
TOOWOOMBA
CUNNAMULLA
GOLD COAST
WARWICK

QUEENSLAND - Q-NET
Centres, Phase 1.

DISTANCE EDUCATION FROM A NON-DIGITAL SOURCE: SOME SUGGESTIONS FOR DIGITAL DESIGNERS

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Chico, California USA 95929-0250
(916) 895-6105 Telex: 377313

1. Abstract

California State University, Chico has been involved in distance education since 1969, when faculty began driving throughout the region offering External Degree programs. In 1975 a television network was established in northern California and in 1984 CSU, Chico began broadcasting, live via satellite, an entire M.S. degree program in Computer Science to North American locations.

2. Introduction

"...I don't envy anyone who has to advise his [or her] country what to buy--or to accept as a gift--in the telecommunications field during the next few years. Or, for that matter, for the rest of the century. By 2001 everything we have now will still be operating somewhere. And it will all be obsolescent" (1).

This statement by Clarke is appropriate for a telecommunications meeting. Chances are that some decisions made throughout this meeting will be wrong, but we attempt to make intelligent decisions for the future based on the most current information we have. It is nice to remember that where foresight can be considered a 50/50 decision-making process, the wisdom of hindsight is always 20/20!

Wedemeyer wrote that "the future is not something waiting to happen; it is not something preordained; it is within the power of the membership [of the PTC] to create it" (2). As a new member of PTC, we wish to share some experiences for planners of the future of PTC. As Franco has pointed out, "the Pacific region may well become the most advanced in its applications of communications technology, hence the considerable interest in PTC's activities by governments as well as by enterprises" (3).

In placing PTC'86 into perspective, we are reminded that on Tuesday, January 13, 1903, an earthquake in the Tuamotu Archipelago killed more than a thousand people. The Tuamotus, in French Polynesia, as well as other island groups, have had their share of devastation as a result of natural events. A disaster of eighty-three years ago or a hundred and eighty-three years ago would have taken months, if not years, to reach concerned individuals. When disasters do occur around the world, we are literally tied together as a result of world-wide telecommunication networks. This is the point that the Director General of INTELSAT, Richard R. Colino, made at a San Francisco meeting in October 1985, referring to the disastrous Mexico City earthquake in September: "...if ever there was a demonstration of the essentiality of modern communications in the life of a great nation, it was during that unhappy week" (4).

3. Evolution as adaptation through time

"The unit of survival [or adaptation, one might add] is organism plus environment" (5).

The Pacific Anthropologist Bateson would certainly see the current and planned electronic environment causing rapid changes throughout the world, especially in the nations of the Pacific Basin. Buczkowska's 1982 PTC paper, "Towards 2000....," (6) points out that predictions can be hazardous. PTC'85, centering around the technology whereby voice, data, and video are encoded for transmission purposes, also pointed out the problems when one gets into predictions. We are reminded of the following statements of DeForest and Zanuck: one was a noted inventor and the other a television producer. They both made interesting predictions on television:

"While theoretically and technically television may be feasible, commercially and financially I consider it an impossibility, a development of which we need waste little time dreaming" (7).

"Video won't be able to hold onto any market it captures after the first six months. People will soon get tired of staring at a plywood box every night" (8).

Predicting is hazardous and we would like to dwell on that which is known and move from the past into the present and then into the future.

At PTC'84, Challenor et al., gave an excellent broad overview of "International Tele-Education" (9). Various articles over the years at PTC and other meetings have dealt with specific telecommunication case studies around the globe: Crowder *et al.* dealing with Canada (10), Northcott on Fiji (11), and of course Walp's 1982 volume on Alaska (12). Literature on telecommunications is increasing at an accelerating pace. Tongo and Grantham have provided us with information on "The Telecommunications Revolution and Higher Education" (13) and Agrawal has dealt with the Indo-U.S. SITE Project (Satellite Instructional Television Experiment) (14), and Hurd's analysis of communication needs for Pacific Islanders is well known (15 and 16).

While one is trying to do something in the current situation, one must also continually keep abreast of what other individuals and organizations are doing.

4. The California Case Study

"In citing Chico as number one, respondents repeatedly cited the university's instructional television program that serves rural communities throughout northeastern California, its continuing education program and external degree program and computerized library" (17).

CSU, Chico is part of the 19-campus California State University System. In 1984, Chico was rated the most innovative campus in the system. The other segements of public higher education are the 106 community colleges and the nine campuses of the University of California. Telecommunication at Chico has been described in various sources (18, 19, 20, 21, 22, and 23). Chico has been involved in distance education with closed circuit television since 1975. Sites have been established throughout northern California and the system has evolved into an integrated network of 16 sites [Figure #1] with various degree programs [Appendix I] and individual courses delivered via television.

The author of the quote which began this section wrote that Chico "makes the most of an isolated environment." Chico has the largest service area of the various campuses: 33,000 square miles (or 85,470 square kilometers or approximately 21% of the State) with a population of 600,000 individuals (or 2.1% of the State). The question which had to be addressed was "how to provide quality education to the individual not on campus?" In 1969, CSU, Chico began offering fully authorized "External Degree" programs at community college locations in northeastern California. Cycles of programs were offered by faculty driving to various locations over the years. Hundreds of degrees were awarded in this manner.

In 1975, through various funding, including system-wide monies and federal dollars from the United States Department of Commerce (NTIA), an Instructional Television Fixed Service system was established between CSU, Chico and the University of California at Davis, 92 miles (148 kilometers) south of Chico. The system was started between Chico and Davis, because Davis wished to use Chico Computer Science courses for their Ph.D. program in Computer Science. From that initial ITFS link, the Chico system has expanded to the current network of 16 sites. At CSU, Chico we take ITFS to stand for "Instructional Television For Students."

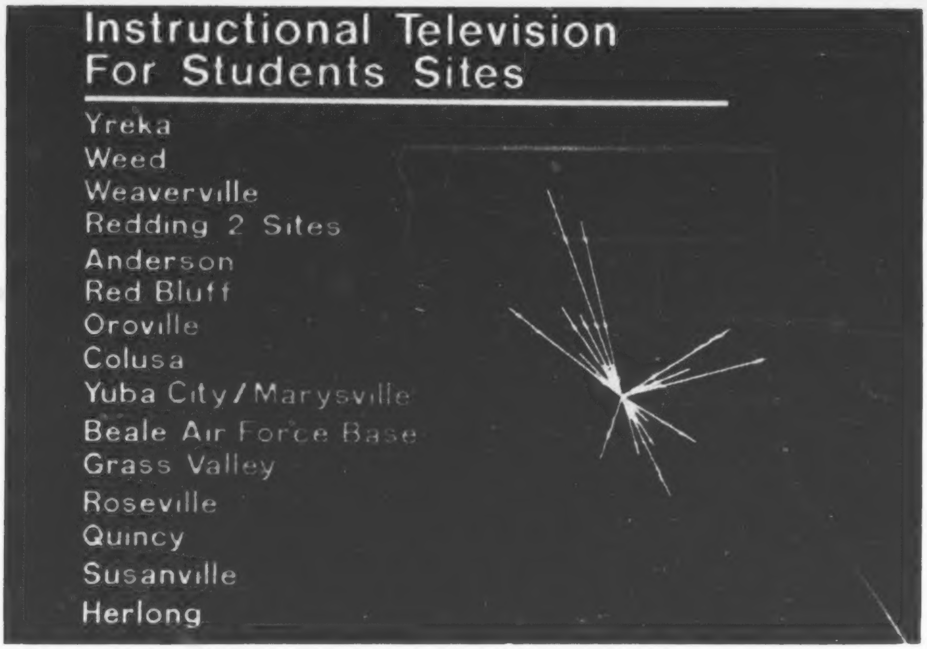
The most distant ITFS site is in a high school in Yreka, 173 miles (278 kilometers) north of Chico. The eastern leg goes 140 miles (225 kilometers) over the Sierra Nevada into the United States Sierra Army Depot. The southwest leg goes to a county schools office in Colusa, 49 miles (79 kilometers) and the southeast link goes 114 miles (183 kilometers) to Hewlett Packard facilities in Roseville, California.

The first television classroom had hanging microphones and one camera. Today, the ITFS classroom, where on-campus students take their regularly scheduled classes with off-campus students, is a state-of-the-art facility. The courses on ITFS are taught by regular on-campus faculty to on-campus students. The off-campus student pays the exact same fees as if she or he were attending class in Chico. CSU, Chico provides a one-way video, two-way audio system which is live and interactive. The ITFS classroom, with four television cameras, can seat 32 individuals. The instructor has a wireless microphone and there are sixteen microphones so the on-campus students can interact with the off-campus students.

The classroom, operated by one individual, transmits 8AM to 10PM every Monday through Friday and Saturday from 9AM to 3PM. Classes are broadcast 2,160 hours a year (2 semesters x 24 courses a semester x 45 contact hours/course) providing electronic reception for 34,560 instructional hours at the 16 sites. Last year, had courses been offered by faculty driving to various sites, it would have cost Chico $250,000 in auto expenses and 9,000 travel hours.

Through ITFS, CSU, Chico has created 16 classrooms without (a) increasing the faculty, (b) constructing 16 rooms and (c) incurring maintenance for those 16 rooms. Because of programmatic demands, a second origination room will be available by September 1986. In addition to the electronic delivery of courses and degree programs, the University's entire library card catalog (in excess of 1,000,000 items) is in machine-readable format, accessible throughout the region (and nation) via computer. Not only do we provide courses via the electronic medium, but also the necessary support services for fully-rounded programs.

As the terrestrial system was being completed, Chico began to look to satellite-delivery of degree programs. In 1984 the University installed a 10 meter uplink on campus and in September of 1984, Chico began offering an entire Master's degree program in Computer Science, live, via satellite, for 12 hours a



Instructional Television
For Students Sites

- Yreka
- Weed
- Weaverville
- Redding 2 Sites
- Anderson
- Red Bluff
- Oroville
- Colusa
- Yuba City / Marysville
- Beale Air Force Base
- Grass Valley
- Roseville
- Quincy
- Susanville
- Herlong

Figure 1: The CSU, Chico ITFS Network in Northern California

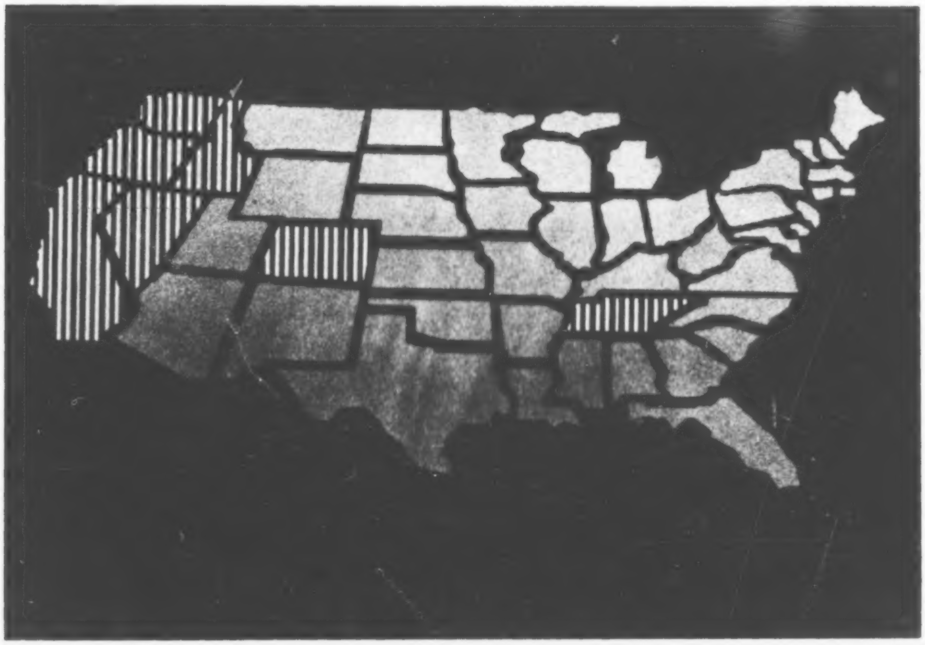


Figure 2: Locations of Courses Received Via Satellite From CSU, Chico

week to industrial sites in five Western States, including California. Eight graduate courses were offered from September 1984 through May 1985 with 100 enrollments each semester.

The live satellite program has been expanded to 15 hours per week (every Tuesday and Thursday from 8AM PST to 3:15PM PST) and now includes Texas Instruments and Bently Nevada. In September 1985 there were 140 enrollments in five courses at 13 corporate locations in 6 states (California, Washington, Oregon, Idaho, Nevada, and Tennessee) [Figure #2]. In the Fall of 1985, Chico also had 376 enrollments in the 27 courses on ITFS in northern California.

As with ITFS, the faculty are teaching their regular on-campus students at the same time they are teaching professionals via satellite. In the satellite program, companies do pay fees and tuition to cover faculty salaries, satellite transmission, and administrative charges. Negotiations are under way with other corporations to expand the satellite program and discussions have been held on offering the degree via satellite beyond North America.

A cycle of 20 courses has now been prepared [Appendix II], running from 1985 to 1987, which will enable individuals to complete an M.S. degree in Computer Science without coming to the CSU, Chico campus. As the Continuing Education Manager for Corporate Engineering at Hewlett Packard has pointed out: "technology can help compensate for the shortage of engineering and math faculty and can make education accessible to isolated areas. But to maximize these opportunities, careful planning and resource sharing are absolutely necessary" (24).

The 1985 Compendium entitled Uses Of Instructional Television In Engineering Education In The United States pointed out the activities of CSU, Chico and also the televised courses of Stanford University, the University of California at Berkeley, Purdue University and Oklahoma State University, just to mention a few. Several institutions are using the latest technologies to deal with the distant learner and a recent article pointed out the following:

"Perhaps most ambitious of all, Chico State University in California has begun offering some of its graduate-level classes to students as far away as Johnson City, Tenn. In fact, Chico's satellite hookup could allow the school to transmit courses throughout the Pacific Basin--a third of the globe" (25).

The Center for Regional and Continuing Education is the major outreach office of CSU, Chico, charged with coordination and development of teleconferencing. A "4-C" framework has been established to deal with telecommunications: the coordination of a project, either via ITFS or satellite, is handled by Continuing Education. The conduit or delivery system is maintained by the University's Instructional Media Center. The client or the customer makes a determination, with the University's experts, what content is to be delivered via the appropriate electronic medium [Figure #3]. This framework applies to numerous situations, and if all of the variables (and sub-variables) do not work together, one quickly gets an additional unwanted "c" variable, namely chaos!

The Center oversees numerous aspects: student admissions and registration, material distribution between faculty and students, examination proctoring, and providing materials and training for off-campus site coordinators. The Center is the focal point between the site coordinators and students and the various CSU, Chico on-campus offices. All telecommunications programs have total University support and numerous offices are involved in the program.

The Office of Admissions and Records has simplified the normal six-month admissions and registration process into one envelope, available at all off-campus sites at the beginning of each semester. A Student Handbook for the off-campus student has been prepared and the Instructional Media Center, which maintains all of the on-campus and off-campus telecommunications equipment and facilities, provides faculty orientation workshops each semester for faculty teaching in these programs. A publication entitled Teaching Over Television has also been created for this purpose (26).

For the M.S. in Computer Science Program, the Center has developed an "Instructional Manual" for the training coordinators at the various locations which details the program's various policies and procedures. Because this program spans the North American continent (encompassing three time zones), the manual also covers such things as the University calendar, how to order books, how to access the on-line University catalog via computer terminal, which on-campus office should be called to get answers to various questions, and even what particular equipment is needed in the individual receive classrooms across the nation. Because this live satellite program is handled by a single University offering a single accredited M.S. degree in Computer Science, most problems and administrative concerns can be handled by one phone call to the Center.

Discussions are currently under way concerning the establishment of an electronic mail system between CSU, Chico and the various corporate sites involved in satellite program. This electronic bulletin board would be in addition to the access the off-campus students already have to the campus computers. CSU, Chico's long-term involvement with ITFS in northern California and the live and interactive M.S. degree in Computer Science available via satellite, combined with various support services, is a clear indication of the University's commitment to higher education.

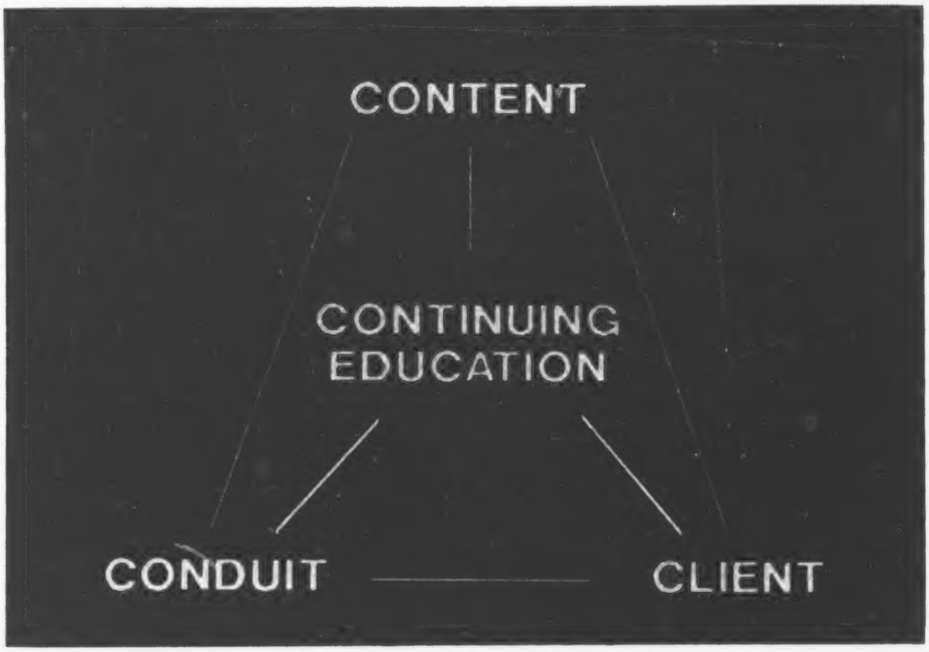

CONTENT
CONTINUING EDUCATION
CONDUIT
CLIENT

Figure 3: CSU, Chico "4-C" Framework

5. What we would have done if....

"The major objectives of industry are to reduce expenses, maintain competitiveness, and increase profits. Sub-objectives include the need to optimize communications among sites, to increase productivity of international operations, and to reduce the time spent in travel and meetings" (27).

Lissandrello's statement is excellent for many occasions. In order to "maintain competitiveness" one must be aware of what is currently going on the the area of distance education via telecommunications systems. It is interesting to note that The RAE Table Of Earth Satellites 1957-1982 by King-Hele et al. (28) pointed out that between the years 1957 and the end of 1982, there were a total of 2,389 known launches of various satellites. This works out to a launch on the "average" of every 3.82 days over the twenty-five year period! In November 1985, Hudson wrote that "there are now more than 150 commercial satellites in geostationary orbit (GSO), 60 percent of them launched within the past five years" (stress added) (29). Changes are occuring very rapidly.

What have we learned throughout the years of telecommunications activities at Chico? One must be aware of what has already occured and what is currently going on in order to plan for the future and long-range planning is a must.

Not only do potential clients need to know what your plans are, but in order for you to continue to expand your own programs, you need to know where you might want to be in the next five years. Although long-range planning and committee work is not the most exciting thing to most people, we would simply like to stress this: no one single individual nor any single unit on a University campus, or in an industrial organization, knows everything in order to make the most absolutely-perfect correct decision about the future! One must be willing, however, to make decisions, but with the full realization that some of those decisions might in fact eventually be the wrong ones.

What would we have done differently? Even given the 20/20 vision of hindsight analysis, probably not very much. We had to adapt to the northern California environment with the appropriate technology of the day, which was an extensive ITFS/Microwave system. Satellite delivery to rural California would not have proven cost-effective or feasible in 1975.

Our satellite activities are keeping us busy, and given the wisdom of hindsight, perhaps we should have looked at a Ku-uplink system as well as our C-band uplink system. We are, however, right now exploring the possibility of a Ku-band uplink on campus. We are also looking to, and recommending that individuals and organizations, analyze the various codecs that might be appropriate for their unique situations. There have been many changes since we first became involved in telecommunications in 1975 and often one wonders what the next decade (or next five years) will bring to the educational arena.

6. Recommendations and General conclusions

"I have yet to see any problem, however complicated, which when you looked at it in the right way did not become still more complicated" (Poul Anderson).

If California State University, Chico, were planning its ITFS/Microwave system right now and its satellite activities, our recommendations would be (a) continued master-planning/long-range planning, (b) development of the ITFS/Microwave system for the area of 33,000 square miles of northern California, and (c) investment in the necessary up-link equipment for both full-motion video and compressed video in both the C-band and Ku band frequencies.

As programs grow, so does the need for physical space, including classroom and studio space as well as office and storage space and we would recommend keeping this in mind. Keeping track of classes, students, enrollments and all of the elements of a distance education program is a large and time-consuming effort and we have found our own in-house computer system an essential item for both the ITFS and Satellite program and strongly recommend such a system.

The University is a member of the Pacific Telecommunications Council and we also hold memberships in the National University Teleconference Network (NUTN), the Public Service Satellite Consortium (PSSC), and the National University Continuing Education Association (NUCEA). The activities of each of these organizations helps us keep abreast of the changes in telecommunications and gives us an added perspective of our role in this field.

There is a great deal of printed matter that must be consumed (or absorbed or at least glanced at) in order to attempt to keep up with the "analog and digital deluge" that threatens to engulf us all: Aviation Week And Space Technology, BME, the CITE Newsletter, Communication Age, Communication News, EITV, IEEE Spectrum, Telephony, Satellite News, Satellite World, Space Calendar, Telecoms, Telephony, and Telespan just to mention a few! And, of course, there are the various PTC publications that are necessary readings.

Keeping up with what is happening in this rapidly changing field is extremely important. This means that time and money must be allocated to key personnel (both technical and non-technical) to attend professional meetings and visit other institutions and organizations involved in telecommunication activities. Not only does this bring new information to your own activities, but it also helps to reaffirm people's professional commitment; and people who work in telecommunications activities, be they digital or non-digital, need to be dedicated individuals.

Wide-spread reading and travelling, attendance at professional meeting, and judicious "borrowing" of ideas to incorporate into the "local" environmental situation is the best way to handle various telecommunication situations. There is no way that any one single individual can keep abreast of everything and a spirit of cooperation and not competitiveness is needed within the organization that is attempting to bring about telecommunication activities.

Our activities represent a teamwork effort: faculty or content experts are needed to develop programs, technical people are needed to build and maintain systems, and administrators are needed to coordinate and facilitate both the development and the delivery of the program to the client and the expansion of the program to potential new clients. Communication channels between individuals in these areas must be kept open and used frequently.

Individuals of this planet no longer live in isolation; we all co-exist in an increasingly integrated information environment. The geographically separated inhabitants of the globe are woven together into an "information society" that is in fact making the world a smaller place. At CSU, Chico we are in the business of sharing information and interested readers of this chapter are encouraged to contact us for any further information.

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Appendix I: ITFS Programs at CSU, Chico

1. California Studies Minor
2. Career & Life Planning Minor
3. Economics Minor
4. Family Relations Minor
5. Geography Minor
6. Paralegal Certificate
7. Political Science Minor
8. Psychology Minor
9. Sociology Minor
10. B.A. in Social Science
11. B.A. in Sociology

Appendix II: Computer Science Courses

Fall 1985

CSCI 151	Data and Program Structures
CSCI 152	Operating Systems Programming
CSCI 171	Computer Architecture
CSCI 231	Computer Graphics
CSCI 397C	Seminar: Security & Privacy

Spring 1986

CSCI 152	Operating Systems Programming
CSCI 172	Systems Architecture
CSCI 256	Theory of Computing
CSCI 322	Artificial Intelligence
CSCI 372	Operating System Theory

Fall 1986

CSCI 151	Data and Program Structures
CSCI 171	Computer Architecture
CSCI 227	Discrete Simulation Systems
CSCI 320A	Digital and Analog Transform Theory
CSCI 350A	Language Theory

Spring 1987

CSCI 152	Operating Systems Programming
CSCI 172	Systems Architecture
CSCI 273	Data Base Management
CSCI 370	System Design Theory
CSCI 397C	Seminar: Computer Architecture

CULTURAL SENSITIVITY AND TECHNOLOGY TRANSFER

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Chairman
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We all know full well that the whirlwind pace of technological change has been, and continues to be, one of the greatest challenges facing telecommunications administrations. That message is so often repeated that it has become rather trite. Of course, advanced technology must be introduced into the network so that the range of services offered customers can be broadened to meet customers' rising expectations, and the value of services to the users increased; and also, so that operational efficiency can be improved and savings in both operational and capital expense realized.

A fact that receives much less recognition, however, is that the management of technology is supremely important. Effective and efficient management of the telecommunications system is the key ingredient in ensuring the smooth, reliable and cost-effective introduction of advanced services and the avoidance of disruption to the network as a whole.

To that end, the education of the system's technical and management personnel is essential. Training programs, as forward-looking and advanced as the new technology being introduced, must be given top priority -- both short-term and long-term -- so that the system's full potential can be realized. The need for trained, forward-thinking management exists in the most industrialized nations as well as in the developing and less developed countries.

For companies such as BCI -- that's Bell Canada International, a management and consulting services -- and for their clients, the development of recent years have presented a double challenge. They have had to cope with the revolution in telecommunications technology and also, in many countries, they have had to deal with a strong sentiment favoring national self-reliance, and an insistence upon national self-sufficiency in the operation of newly acquired elements of the infrastructure. Technology transfer is no longer just a buzzword in our industry. It is an essential requirement of most major telecommunications contracts today.

Many years of experience, in more than 60 countries and through hundreds of contracts throughout the world, have taught BCI that technology transfer does not end with the installation of new hardware. In fact, that is actually only the beginning. Nor does it consist only of training courses and the imparting of technical skills. Technology transfer must lead to the co-ordination and integration of all the systems -- hardware, software and human -- needed to operate a telecommunications organization effectively, efficiently and profitably. And more than that -- it often involves the adaptation of knowledge, methods and skills developed in one society to the norms of a different cultural environment.

Today, I would like to focus on the cultural issues involved in any attempt to transfer knowledge from one group to another. I will try to highlight some of the cultural factors that are most important in training programs, and draw upon BCI's experience to suggest a training development model that can be used to ensure that cultural awareness is built into any training program.

Technology, represented by switching, transmission and control systems, can be obtained now from any number of sources. And it is relatively cheap. In fact, one of the motivating factors in the conversion from analogue to digital systems is that the cost of digital systems is rising at a slower rate than that of traditional technologies. The objective of training is not merely to enable a telecommunications administration to operate and maintain the new systems; nor is it just to understand their operation. The goal is to ensure that the greatest possible benefits are achieved -- in terms which are meaningful to the host culture.

Let me sound a word of warning here. Any practices or measurement indices that have been developed in another culture cannot simply be plugged in to the host culture without modification. If they are not suitably adapted, they might have no value, or be self-defeating. That is especially true for training programs.

One simple example might serve to illustrate that fact. As you are no doubt aware, line-holding patterns are a consideration in the planning and engineering of telecommunications facilities. In Canada, in a given area, be it primarily residential or a business district, average holding times are fairly predictable. However, people of some other cultures are in the habit of having much longer telephone conversations than North Americans. Reliance on the North American norms -- especially in planning for residential areas -- would lead to under-engineering the facilities.

However, there are greater barriers than that which can get in the way of effective training and block the transfer of knowledge. The first step in clearing the path to genuine technology transfer is to acquire as much understanding of the host culture as possible. That leads us to a society's value system.

It is no secret that the value systems of various societies differ. There are subtle differences even between such closely related peoples as the Canadians and Americans, or the Germans and the Austrians, although all of those are part of the broad cultural entity we call "the Western World". But when we venture beyond that world into the Middle East, or Africa or Southeast Asia, for example, we find quite different ways of viewing things, and quite different value sets.

The relative weight attached to religion, family, friendship and business; the role of women; attitudes toward sex and marriage; the importance of work; the rights of individuals versus those of the community; attitudes toward authorities; the positions in society of the young and the elderly -- these and countless other matters are seen in different ways in different cultures. And they must be given serious consideration before a training program is prepared. One must know what is important in the eyes of the trainee.

Psychologists have demonstrated that even the human senses function at different levels in various cultures. Some peoples have more difficulty than others in relating two-dimensional representations, such as a map or diagram, to the three-dimensional reality. Others have a much keener aural sense than Western people, and can distinguish and appreciate subtle tones or hear sounds lost to most of us. (I'm inclined to wonder whether the prevalence of walkmans and "ghetto-blasters" in our society, has anything to do with that).

Of course, language differences can be a barrier to understanding and the effective transfer of knowledge. Language training, therefore, is often necessary before other training can proceed. BCI is fortunate in having access to a large pool of consultants, course planners and instructors whose mother tongue is English, the language in which much of the available telecommunications technical information is written.

History is strewn with the failures of Western societies which tried to create carbon copies of themselves in other lands. Colonial administrations did not try to get too close to their alien constituents for fear of "going native". But they failed to convert them into Britons, Frenchmen, Belgians, Germans, Italians, Dutchmen and so on. While there might remain some residue of the lifestyles and institutions of the colonial powers in their now-independent former colonies, for the most part, those new, sovereign nations hold their own values and go their own way.

In more recent, post-colonial times, a quasi-colonial mentality seems to have persisted in some of the efforts of peoples of industrialized nations to transfer technology to other peoples. However, even a deliberate effort to avoid any taint of arrogance can often produce only failure. There are a number of scenarios which have all been played, repeatedly, and which have been unsuccessful in international training programs.

There is the instructor so taken with the cultural differences and the need to walk as if on eggs in the strange environment that he "goes native" and the training message is not transmitted.

Or, it could be that the host culture simply is not ready for the message, but people are too polite to say they don't really see any need and do not intend to change.

Another scenario is one where the trainer stays in his own little world, enclosed in a cocoon of back-home culture. The people of the host culture watch him, let him "do his thing", but as soon as he leaves, things return to normal. There is no effective transfer of knowledge.

Still another scenario that has been acted out repeatedly has a bright young person sent to a technologically advanced country to study the technology and return with it to benefit his home country. But, while he is away from home, other opportunities beckon. He never returns to his native land. Another bright student will return, but has become so imbued with altered values and has such a changed outlook that it interferes with his bringing maximum benefits to his homeland.

Now BCI is in the business of transferring knowledge, and through its experience in more than 60 countries, has learned, mostly by trial and error, to avoid the pitfalls I have just mentioned. It is easy enough to ship a camera, an automobile or a TV set to another country. Cultural differences have minimal effect in those cases. The transfer of telecommunications know-how is something else.

BCI has come to the practical conclusion that culture is not a totally transferable commodity. There will always be gaps between cultures. No one personality nor a single brain is capable of containing all the cultural awareness necessary as well as the requisite technical and managerial knowledge that successful technology transfer requires.

As a result of that conclusion, BCI has evolved a method that has worked well, and I would lke to share it with you for your consideration. Although the transfer of technology cannot be achieved overnight, a systematic and sensitive approach can produce results within a reasonable time.

BCI takes a dual approach to cross-cultural training. One trainer is a technical specialist. The other is a cultural facilitator. It is important that the cultural facilitator be from the host culture. The two work in harness together, exchanging ideas and resolving problems as they arise in implementing the training program.

This combination produces training that is sensitive to both sets of goals -- the goals of the culture and those of the technology. Cultural compatibility is achieved within the learning process, not in addition to it.

To illustrate the importance of cultural awareness we do not have to travel to some remote, exotic society. There are examples of the importance of cultural awareness to be found right in North America's largest cities, and they pertain to the introduction of advanced office information systems and computer literacy. Many firms have found to their discomfiture that, unless there is complete cultural acceptance of the new technology by the entire office staff, the technology is doomed to misuses, or is not used at all.

One advantage that BCI had had in ensuring cultural compatibility in the development of training programs for people from a great diversity of cultural milieux has been that the company has had relatively long periods of involvement with many cultures -- sufficient time to get to know and understand their values, traditions, laws, customs and motivation.

I do want to emphasize the importance of nurturing the relationships and gaining the understanding which makes possible the development of culturally compatible training. We have been able to conduct training programs in an evolving environment, with continual support, advice and feedback from the clients.

In preparing a training program, the analysis of training requirements must be done from the top down in the host organization. Frequently, at various levels in a client organization, attitudinal changes are necessary. It would be futile to attempt to introduce the job planning review process, for example, if that concept was outside the cultural orbit of the student.

The student must first be convinced of the need for job planning reviews. His attitude must be changed because the needs for it are revealed to him, either through examples from other cultures, or by his confrontation with his own needs. The consultant can help to compress the time required for such attitudinal changes.

In one of BCI's major projects the objectives, initially, were to ensure that the telecommunications system would function during a period of extremely rapid expansion and upgrading, and to train the personnel of the host organization to operate and maintain the system themselves. At first, BCI's own forces virtually managed the day-to-day operation. In fact, the company imported some 50 of its own installers in an effort to ensure that expansion targets would be met. In the initial phase, much of the training was technical and basic in nature -- installation and repair, business office, central office maintenance etc.

Although a few of the Canadians who then were filling management positions throughout the host organization might have thought that their role was to create "a replica of Bell Canada abroad", most of them knew better, and the higher managers clearly recognized that the organization they were helping to build must serve the needs and take into account the values and objectives of the host country.

There was give and take on both sides, of course. People of a culture in which everyone customarily had instant access to the head man -- one chief and all the rest Indians -- began to see the merit of a hierarchical management structure and the functional division of responsibilities. While formal training programs were implemented, a good deal of learning was accomplished through day-to-day contact with our people; a process of osmosis.

Gradually, through classroom training, seminars and on-the-job coaching -- and, above all, the dual approach to knowledge transfer -- managers in the host organization gained an appreciation and understanding of such concepts as management by objectives, and the need, as well as the methodologies, to manage and operate the telecommunications network as an integrated, coordinated system.

Over time, the role of the BCI personnel changed. They became more and more advisors and less and less managers, as the managers of the host organization, having learned their lessons, took firmer control of the organization. Eventually, plain old telephone services were almost completely managed by nationals of the host country, and the advisors were able to concentrate on the more sophisticated aspects of telecommunications, such as data and enhanced services. The process of technology transfer was well on the way to becoming complete. But the system is theirs; designed to serve their needs; compatible with their culture.

That experience typifies an approach which is a far cry from merely selling a training package. The client and the consultants rub shoulders, grow together, sharing experiences, and the consulting staff move in a relatively short time from a "hands-on" managerial role to that of advisors to counterpart managers of the client administration. Culturally sensitive training on the job, and in-country and out-of-country classroom sessions accelerated the process.

Recently BCI has been applying the experience gained in two decades of international telecommunications training in an endeavor to address a largely neglected area -- the management of telecommunications administrations at very senior levels. Five major Canadian telecommunications organizations are collaborating in the development of a program and facilities which will bring together the leaders of telecommunications administrations from countries -- both developed and developing -- around the world.

The Telecommunications Executive Management Institute of Canada, which is fully supported by the Canadian government and the entire Canadian telecommunications industry, is expected to commence operations later this year. It is the belief of those taking this initiative that the training of executives of telecommunications administrations -- beset as they are with a bewildering number of problems -- can produce significant benefits for those telecommunications organizations in a relatively short time. If those executives could control effectively their present funds, equipment and manpower, it could confer enormous benefits -- in terms of telecommunications services -- on their people.

And surely, ladies and gentlemen, benefits for the people -- in their own terms -- is the ultimate objective -- the raison d' tre -- of all training programs and all telecommunications services.

Training - Critical Issue in Digital Pacific

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Abstract

Telecommunications of the world tends toward the Integrated Services Digital Network, implementation of which will be based on the digital switching and transmission systems. Digital technology is already replacing the old electromechanical systems and soon it will become the only technology available from the manufacturers. Training of suitable personnel to install, maintain and administer these new systems becomes a critical issue if Digital Pacific is to be a successful and working reality.

1. Introduction.

It may be true that there are still places where people use two tin-cans and a piece of string to talk to each other but by and large voice communication systems and networks today allow to talk to any point in the world, and even beyond it.

The telecommunications networks have outgrown the national bounderies and are now interconnected to form a global, world's network. The telecommunication network consists mainly of two basic components: switching systems to establish connections between desired points and transmission systems to carry electrical signals.

Switching systems have developed from the rather primitive manual switchboards to the fully automatic systems, based mainly on the well proven and reliable Crossbar principle. Perfecting electromechanical systems to the present state took around 50 years. During this time sophisticated technological processes were developed to provide reliable components, new switching philosophy was worked out to allow more effective usage of expensive circuits and enormous investments were placed in the telecommunications facilities. Transmission systems, developed almost simultaneously, provided better and more reliable transmission channels. Both switching and transmission technologies have developed on the basis of the analog signal being transmitted from end to end. As a result of this development telecommunications network has spanned the world, automatic voice connections between any points in the world are common place, there are numerous cables across the oceans providing continuous transmission channels, satellites were placed in the orbit to further increase transmission capacity and to provide access to places which not so long ago were beyond the reach.

It is well established and confirmed that efficient telecommunications system is a major factor in stimulating the growth of commerce and industry and therefore contributing to the growth of national product. Conversely, it is also confirmed that where communications does not follow the rate of growth of commercial activities it decelerates the national economy, rather than to support it.

The last 20 years brought staggering changes in the fields of telecommunications and electronics. Computer industry has developed from the stage of expensive experiments to the present day environment. Computer equipment, which only 20 years ago was hardly possible and costed hundreds of thousands of dollars, is generally available and can be purchased for a small fraction of this cost. Communications channels are no longer limited to copper wires buried in underground or undersea cables but are available in the form of microwave links, satellite links, optical fibres, laser beams, etc. all of which offer ever increasing capacities and economies. Coupled with technological changes were social changes reflected in the desires for better living conditions, shorter working week etc. In effect the cost of living was increasing and so was the cost of manufacturing of goods and of their maintenance.

The economic factors were probably the initial reasons for the designers and manufacturers to search for better, more economic, more reliable, while more efficient telecommunications equipment. The unprecedented development in the electronics industry resulted in arrival of the Integrated Circuits which made the cheap, reliable and highly complex electronic components easily available. It was natural that great effort was directed towards the development of the new switching and new transmission systems which would allow for cheaper manufacturing process at the same time ensuring better and more reliable performance. Ever expanding computer facilities required transmission channels between them and hence digital transmission channels were established.

Switching systems changed from the electromechanical machines into fully electronic, digital switches. Transmission channels instead of being exclusively analog in nature are increasingly digital. The new concept emerged in which it was visualised that if only it would be possible to represent all telecommunications services in the form of one, standard electrical signal then instead of numerous communications networks, as we have them now, only one universal network may be possible. It was quickly recognized that such a universal signal which ultimately may carry all possible information is the digital signal as used by the computers. And so the idea of the Integrated Services Digital Network (ISDN) was born.

Telecommunications industry changed to meet growing demand for digital equipment and at the same time manufacturing of the electromechanical switching systems began to be phased out. There are currently very few major manufacturers still offering electromechanical switching systems and it is believed that in the matter of few years this type of equipment will disappear from the market. This is the scenario of telecommunications of today and is applicable to countries within the Pacific Basin as well.

2. Development of the ISDN.

Although the idea of the ISDN seems to be sound and there are little doubts in the eventual success, there is still quite a distance to cover. First - technology must be perfected for few more years before it will be generally ready for this advanced communications concept. Secondly - for the global network to operate successfully certain standards must be worked out and agreed upon. There are at least two major international organisations working in this field (CCITT and ISO) but their work is far from being completed. Thirdly - capital investment in the existing facilities must be at least partially recovered before replacement with modern technology will be acceptable.

The Pacific Basin countries may soon find themselves in rather peculiar situation, in which although they have acquired reasonable communications facilities based on the electromechanical switches, no further expansion or replacements may be possible as all equipment available from suppliers will be digital. Irrespective, therefore, that the ISDN concept is some time away they may be forced to accept into their networks digital switches while the old electromechanical systems may still be in service. The gradual introduction of digital technology is consistent with the general trend toward the fully digital ISDN environment while the existing electromechanical systems are still being used. This introduces immediately two problems: the interworking between electromechanical and digital systems and introduction of new technology which must be installed, maintained, administered and planned for.

3. Transformation of telecommunications network.

The gradual process of transformation of the world's telecommunications network into completely digital environment is already underway. In some countries it may be faster when stimulated by high demands and economy, but it will eventually come to all places which participate in the global communications. With this in mind lets examine how introduction of the new technology will affect Administrations of the Pacific Basin countries.

First, at certain time - expansion or upgrading of the existing communications facilities will be required. In near future Administrations may find that electromechanical equipment is no longer available at reasonable prices. They will be offered instead an ever increasing range of electronic equipment which can perform all necessary functions in the complex communications network. The first problem, therefore, will be simply to make a right choice of a system. This in itself requires quite a knowledge supported by statistical data collected from installations already existing for reasonable decision to be made. One may claim that such knowledge and experience may be acquired to some extent by extensive training.

Secondly, after choice has been made and some equipment is ordered it will be installed and commissioned. During the installation period there is a chance to acquire indepth knowledge of the new system, which will be useful later on, but to make it effective personnel assigned to this task must already have some background knowledge of electronic switching and transmission systems.

Thirdly, after installation has been completed and equipment is commissioned normal service commences. However, telecommunication systems are well known for the lack of long term stability in their working environment: changes to the installed equipment are everyday occurrence and they start from the day of cut-over. New subscribers are added, new trunk lines are established, traffic pattern changes due to external conditions, equipment must be expanded, etc. All those activities fall within category of maintenance and administration. Large manufacturers of telecommunications equipment may be interested in supplying and installing of new equipment but almost as a rule maintenance and management of it belong to the Administration. In reality there are only two options available: either all those tasks will be carried by Administration's personnel or trained specialists must be hired on contract basis from somewhere, which usually is an expensive alternative. It must be recognised that only local personnel will have thorough and indepth knowledge of the local conditions and needs and therefore it will always be preferable that the above tasks be carried by Administration's personnel, but they must be well trained if their effort is to be successful.

Finally, as was already mentioned, telecommunication systems are always changing. Changes are introduced due to the natural growth of social, commercial and economic life, growth which if properly recognized and documented may be planned for. Such planning refers not only to new roads, housing, town facilities, power supply, etc., but applies equally to the development of telecommunications. Planning for future growth of telecommunication systems is not easy, it involves continuous collection and analysis of statistical data, while at the same time social and economic development is carefully monitored, but even then final act of planning involves great degree of guessing. If growth estimate was correct then timely expansion or modernisation will be allowed for with minimum possible cost and maximum benefits, while on the contrary if estimate was wrong the only result will be increased costs and deficiencies in communications which may reflect on national economy.

All those considerations lead to the same conclusion: suitably trained personnel is essential if continued service and upgrading of telecommunications facilities is to be successful. There were cases where Administrations for number of reasons chose to attend to the needs of telecommunication network as and when needed. Equipment was selected on the basis of suppliers' offers, it was installed by the selected supplier and then maintained under the contract. However, as technology changed and economic conditions might have been better elsewhere technical support for the system installed was diminishing leaving Administration eventually with unserviceable equipment, with no support available either externally or internally, resulting in effect in great losses.

This scenario is further complicated by the arrival of the new, digital technology, where old skills acquired during many years of electromechanical systems' service are not always applicable. Fortunately, the arrival of digital technology is gradual, there is still some time left for final preparations and it would be prudent that suitable steps be taken to prepare Administrations for coming changes. Probably the most critical issue, in the long run, is suitable training.

4. Training requirements.

4.1 General requirements

Basically training requirements may be divided into two major groups: short term training and long term training.

Short term training will be required for personnel involved in: installation, commissioning, maintenance, expansions, and first level administration of telecommunication facilities.

Long term training will involve engineering support and higher level administration of telecommunication facilities.

In the first group, subjects relevant to professional duties may be given in a form of a specialized courses devoted to the specific areas. The courses will be organized from time to time, their duration may be anything from 1 to 4 months, depending upon the specific requirements. One or more of such courses may be run concurrently, if desired, and if suitable training resources will be available. It is generally assumed that the course participants will primarily be technical officers directly involved in installation, commissioning, maintenance and basic administration of telecommunications systems, and that they already have certain background knowledge of telecommunications. Attendance of these type of courses may form part of the continuous education scheme and/or they may be considered as refreshing or updating courses.

The second group of training is more involved. It's aim is to form a telecommunications engineers with additional, specialised knowledge in certain parts of telecommunications so that they could be usefully employed by the Administration to perform various duties encompassing management and development planning of telecommunications facilities. Very specialized, in depth knowledge of operation of the various systems may not be necessary, but good general engineering background, with additional knowledge in areas of systems administration, traffic engineering, planning and forecasting techniques, statistics, electronic switching and networking are essential. It is obvious that such a wide knowledge can hardly be acquired from short courses, but rather it must be mastered in the process of long term teaching programs conducted on the tertiary education principle. It seems, therefore, feasible that suitable elective subjects should be included in the Electrical Engineering Department Syllabi at the appropriate Universities. Graduates will be electrical engineers with specialised knowledge in Telecommunications and will constitute a base for the Administration from which to draw professional officers.

Engineering in general and telecommunications in particular are the areas where technology changes are particularly fast. Within past 30 years of telecommunications engineers' careers, they had to convert from vacuum tubes to discrete semiconductors, from semiconductors to integrated circuits and digital techniques, from integrated circuits to optical fibres, etc. In practical terms it means that continuous education and studying of the latest developments in telecommunications is necessary. This is further complicated by the merger of the digital (computer) technology with communications technology, requiring even more efforts to keep abreast with the progress. It will be necessary, therefore, to maintain continuous training for telecommunication personnel in a form of special courses, seminars, workshops, conferences, etc. It may seem to be a rather expensive proposition, but it pays in the long run.

4.2 Short term training.

Considering the multiplicity of various courses required, it will become apparent that training effort will be practically a continuous activity. It will be justified, therefore, to establish a permanent telecommunications training centre where appropriate staff and resources may be allocated. Many Administrations already have such centres in operation and it may only be necessary to modify training courses. Specialized courses which should be included in the teaching programe are e.g.: Electronic switching principles, Electronic switching systems, Digital electronics, Basic statistics, Networking principles, Basic teletraffic engineering, Advanced teletraffic engineering, Multiplexing techniques, Digital communications, Digital networks, Digital microwave radio, Optical fibre principles, Optical fibre in telecommunications, Statistics and computers as maintenance tools, etc.

4.3 Long term training.

Tertiary education Institutions are established practically in all countries within the Pacific Basin and all of them have Electrical Engineering Departments. For a number of years the profile of the graduant electrical engineer has been modelled on the principle that he/she should have sound and wide theoretical background knowledge, while practical, specialized professional training was assumed to be provided by the relevant industry. This works well in the countries where telecommunications and electronics industries are large and well established. If this principle is followed in countries where industry is limited to primary products, but nevertheless requiring modern telecommunications facilities, it creates a shortage of trained professional engineers with the resulting dependence on hired personnel. In those countries it would be preferable that this area of training be undertaken by the Universities. They already have the education base established and it will require relatively smaller effort to modify their courses by inclusion of specialized, elective subjects. These subjects may become compulsory for students sponsored by Administration.

Subjects which could be included in the programs of relevant Electrical Engineering Departments are: Digital electronics, Electronic switching, Traffic theory and engineering, Computers in telecommunications. All graduates will receive B.Engineering degree at the end of studies. Higher degrees, like the M. Engineering or Ph.D. will be more economically obtainable in countries with the telecommunications industry and higher education well established.

5. Planning for training.

It is appreciated that it may be difficult to define exactly the extent of training which would lead to personnel familiarity with a specific system. Such training will depend upon the system selected, size and shape of national network, international connections etc. It is possible, however, to outline general plan for training which if followed will create a pool of trained personnel which can be quickly and efficiently adapted to any system. Such training concept requires some degree of advanced planning and preparations.

The basic component of successful training is skilled teaching personnel. It is generally known within the telecommunications field that well trained engineers which could conduct training are hard to come by and therefore to organize suitable training team and centre takes time. Considering that digital technology is already coming and will become everyday occurrence within not more than 2-5 years, there is not much time left to start training for the future.

It is suggested, therefore, that the following action plan may be adopted:

A. PTC Council to organize a special Working Group which would organise, schedule, supervise and coordinate training courses for Administrations within the Pacific Basin. Such a Working Group should be composed of representatives of various Administrations, nominated Officers from PTC Council and selected professional engineers. They may be based in Honolulu but should hold periodic meetings in various countries within the Pacific Basin. This would allow the members of the Working Group to better understand and appreciate specific needs of different Administrations. Working Group will operate under direct guidance of the Executive Director or his nominee and will report on the yearly basis to the Board of Trustees and to the General Meeting during the PTC Conferences.

B. Administrations within the Pacific Basin will be asked to define as quickly as possible their potential needs in the manpower training.

C. The results of this survey should be communicated on an urgent basis to the Pacific Telecommunications Council with the request to help in organizing and scheduling of suitable training courses.

D. All Administrations which already have training centres established would advise the PTC Council about availability of training personnel, training equipment, possibility of accepting course participants from other Administrations, etc.

E. All Administrations, members of the PTC, would advise the Council about resources which may be available to facilitate training.

F. The Pacific Telecommunications Council would compile a summary of the training needs of the Pacific Basin and will present it during the following PTC conference for general discussion and possible action.

G. PTC Council to make presentation to the ITU requesting possible support and help in the implementation of the training plan. Parallel approaches may be made to the major telecommunications equipment manufacturers to secure their help in conducting training.

H. Progress of activities connected with training should be documented and be reported in the periodic bulletin distributed to all members of the PTC, ITU Secretariat, industries concerned and obviously to all Administrations participating in the scheme.

Considering unavoidable delays involved in organizing training it seems that the following time scale could be suggested as the minimum requirements:

Year 1986 - to form Working Group,
to collect data from Administrations
to compile the basic syllabi of training courses required,
to make preliminary approaches to ITU and industries.

Year 1987 - to prepare detailed training schedules,
to organize training locations, staff, equipment etc.,
to prepare full presentation to the PTC Conference in January 1987
to commence recruiting candidates for training.

Year 1988 - to commence training courses.

6. Summary.

Every month, if not every week, a new satellite is being placed into orbit around the world. Every month and every year the world is becoming more and more dependant on efficient communications, which not only helps commerce and industry, but often it is now essential to survival. This communications will become very soon predominantly digital. Digital technology, intriguing and beautiful as it is, brings with it completely new requirements for the knowledge and skills of those who are going to implement and maintain it.

These new skills can not be acquired overnight but must be developed with careful planning and thorough training. Many Administrations around the world have already paid the price of not having the right personnel at the right time at their disposal. The resulting dependence on the contracted personnel proves to be inefficient and not stable in the long run, situation in which it is extremely difficult for the relevant Administration to plan future growth and development.

Digital technology will come regardless of the state of someone's preparedness and it is prudent, therefore, to make suitable steps to be prepared. It seems that the Pacific Telecommunications Council is ideally positioned to provide relevant assistance to Administrations within the Pacific Basin and to organize and to coordinate efforts towards suitable training. It may be said without exaggeration that such training is absolutely necessary if Digital Pacific is to be a successful and working reality.

Training Needs Assessment - A Case Study

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1. Abstract

Cathay Pacific is a rapidly expanding airline that is affected by an unusual amount of external factors which governs its ability to recruit, train and support its activities. All airlines are in the perishable goods market due to the fact that an empty seat is revenue lost forever. It is therefore mandatory that the information provided to the front line sales force is accurate, timely and more important actually available. The airline measures its success in terms of seat utilization (Load Factor) and revenue earned (Yield).

In these terms the airline can claim to be successful but as its network grows the exposure to aggressive competition is increased. An increasing reliance is consequently made on its ability to keep itself sufficiently informed. The main task for Cathay MIS is to make the most effective use of its resources; man, machines and money. This can only be achieved by defining the task, analysing the requirements and providing the most appropriate resource. In the service industry the most valuable resource is its people. Ensuring that they are not only able but capable of performing the allotted task is the main objective of this paper.

2. BACKGROUND

The Hong Kong environment has undergone a significant change with the advent of the Sino-British Accord. This has not only affected the community in general but the aviation business in particular. The local community has been concerned that after 1997 if it does not hold citizenship of Britain or any other non-Chinese country then they may be locked into the communist system. The effect of this is to create a situation where many of the experienced and talented Hong Kong Chinese have migrated abroad, mainly to North America. To those within the aviation industry this is more apparent due to their greater exposure to world affairs.

For a Hong Kong based airline the Sino-British Accord is supremely important as all airlines are dependent on traffic and landing rights. So far Britain has negotiated all rights concerning Hong Kong airspace with the Governments of international carriers. Obviously this will change in 1997 and is the subject of a specific paragraph within Annex 1 of the Joint Declaration which deals with the Policies on Hong Kong. The above has therefore created a difficult situation in which to not only bring new technology into support a growth industry but retain experienced staff who are concerned about their future mobility. As a result training has had to be carried out whilst integrating new system or even after completion. This has increased the vulnerability of the networked services but has been inevitable in an industry that lives by communications.

3. COMMUNICATIONS PROJECTS

1985 has been the year in which Cathay Communications has been positioning itself to move toward the single workstation concept. This will provide all terminal users with the means to access the multitude of services demanded by a modern airline be they machine based applications or human communications. The initial thrust has been centred on Hong Kong itself being the corporate base. The following paragraphs outline the major developments sponsored by the company to put the training requirements into perspective.

An extensive project now underway to rationalise telecommunications within Cathay will improve backup for the company's major computer systems, make it easier for end users to get terminals and improve the reliability and performance of communications facilities provided for users within Hong Kong.

A four node network using 1.544 Mbit/sec (T1) digital telephone lines is being installed to form the basis of an integrated communications system which will be called CXNET.

Cathay Pacific plans to have a common physical system for carrying data, voice, image and text communication within the company, based on digital techniques - thought to be the first of its kind in Hong Kong.

The components of CXNET are being put together now. The intention is to rationalise, consolidate and standardise all the components that make up the network.

The nodes at Warwick House/the main computer centre, New Mercury House and two of the CPA building at Kai Tak airport use Timeplex Link/1 multiplexor software and hardware. The nodes at the airport will be linked via Cathay Pacific's own cable, while T1 links will be used between the other nodes. The node at Cable and Wireless' New Mercury House acts as the network's communications gateway to the rest of the world.

Most interbuilding data facilities will be phased into the network within the next three months, links to minor sites will follow.

The digital core network will be linked by analogue circuits to three other major sites within Hong Kong, Swire House (Head Office) and the Passenger Terminal Building at Kai Tak Airport. Eventually, a number of travel agents, hotel reservations offices and other companies dealing regularly with Cathay Pacific will also be linked. It is likely that the digital network will be extended to Swire House in the near future. Analogue links will be directly connected to the remaining minor locations in each case in order to rationalise the system. In the event of one of the digital links failing, communications channels will be automatically rerouted round the network in another direction. Communications backup will no longer be carried out manually.

The plan to build CXNET include the installation of a consolidated network of PABXs, providing extensions at all Cathay Pacific locations. A new PABX has just been installed at Kai Tak which will serve all the company's airport buildings. Warwick House computer centre will be added in early 1986. At the end of the initial phase of the project, a Northern Telecom SL1 PABX will be installed at each major site. The network PABX's will then all run under X11 software, enabling a linked numbering scheme to operate throughout the company.

Text services are currently provided in a number of ways. The system is being extended worldwide throughout the organisation and consolidated into a corporate messaging service using the same format as the SITA teletype format, widely used by airlines.

The company wants to enable access from all its screens regardless of type into the system. The first stage will be the introduction of a store and forward system which will output messages to predetermined printers.

The text messaging service will require Sperry/IBM links and trials will be carried out on an Inverted 3270 handler in the near future.

Image communications has only limited application at the moment by the company. A proposal has been made to standardise on Group Three fax machines at all major locations.

Once the digital network is in place the company will have the opportunity to trial video conferencing and to carry out remote security surveillance since both these can be carried out within the bandwidth of the new network.

Videotex will also be added to CXNET as Cathay is considering a number of potential uses of this technology.

Cathay Pacific is piloting SITATEX transmission within Hong Kong and with London. The system provides PC to PC links using a system similar to Teletex for transferring documents.

The airline is also reviewing the use of a voice mail system in which voice messages would be stored in digital form. All the telephone used in CXNET will be touch tone phones enabling them to use voice mail. The use of voice mail would be a follow-on from the installation of the PABX network.

Transmission via packet switching services is also being reviewed but the data terminals used by Cathay

Pacific are synchronous and the local public packet switching service is currently geared for asynchronous communications.

Dragon patch a proposed system from Cable & Wireless has been successfully trialled by the company which allows aircrew to communicate with the voice network facilities whilst airborne in the vicinity of Hong Kong. The airline is awaiting commercial system approval by the Hong Kong Post Office.

Cathays' Information Centre is currently testing and will be implementing software to provide PC/Mainframe links. This additional method of data transfer is increasing throughout Cathay Pacific and requires careful planning and control of communications support.

The payback period for the data component of CXNET is estimated to be two yaers but the main reason for introducing it is to maintain control over provided services.

The installation of four Sperry DCP communications controllers has just been completed. The DCPs will eventually allow users at any of its terminal to access any of the Sperry hosts, subject to the normal security procedures.

4. PEOPLE RESOURCES

The successful introduction of new technology into any business is a combination of user education, preparation and minimising risk.

The large number of Comms projects outlined above has coincided with a period of rapid expansion of the airlines network. This has created additional problems with the demand placed on the organisation to support new remote locations.

The major factor however has been the need to establish a new direction and change the way of thinking in the minds of the communications staff. The past requirement was to provide a piece meal solution to the demands placed upon it in a timely manner. Although this remains basically the same the needs of the airline have to be anticipated, planned and made available in advance of the need becoming apparent. Simple to say, difficult it not impossible to achieve.

Staff who previously reacted to user requests' now have to be able to understand the business needs, be aware of the available technology and look for synergy. Once the opportunity to provide a new or enhanced service has been defined it then needs to be planned, justified and brought into use; quite a different task to that previously addressed.

5. INTERNAL FACTORS

The major factor affecting Cathay's ability to have trained and able staff available to implement new communications technology has been the shortage of skilled local people. Apart from the drain on experienced staff due to the Sino-British Accord the communications community in Hong Kong is small and therefore there has been only limited opportunities for specialisation in the technology. Very few general courses are available most being designed and presented by manufacturers in areas related to their own products. Another factor is related to Chinese culture in that from early childhood the element of encouraging individualism is implicitly suppressed by the regimented approach to education. This is not to say that the people are not enthusiastic and willing to learn but more that innovation is no longer a natural attribute which tends to restrict lateral thought. Most literature is printed in English rather than Chinese which when learning a new technology further impedes the speed of absorption and full understanding.

6. EXTERNAL FACTORS

The airline community has developed into a very specialised industry with the specific aim of serving the travelling public. It has to contend with supporting its operations at vast distances from its home base whilst providing a fast and efficient service to a demanding clientele. Huge investments have been made to optimise the use of expensive communications equipment and services by creating quite unique line protocols.

In 1949 a cooperative, non-profit making organisation was formed by a group of airlines seeking a rapid reliable and economic solution to their telecommunications needs. Eleven airlines pooled their resources for the benefit of all. This organisation is SITA (Societe Internationale de Telecommunications Aeronautiques). Today SITA has become a truly international organisation serving more than 250 member companies and operates the world's largest specialised telecommunications network in more than

150 countries and territories.

By definition the knowledge of SITA procedures, protocols and services is held by those engineers already in the business and must be gained by those entering it.

Hong Kong with a population of over 5 million people finds itself midway between the European and North American sources of technology. Consequently manufacturers are offering differing solutions to customer needs based on their home markets and generally with less than adequate local technical support.

Further the Hong Kong PTT, Hong Kong Telephone Co., is recovering from its divestiture program begun in 1983 and is rapidly establishing itself in the commercial area. However during the changes the various associate companies are positioning themselves to become competitive, aggressive and moreover profitable. This has the effect of diluting the indigenous expertise into diversifying activities.

7. FUTURE PLANS

The aviation business is becoming more and more competitive as airlines strive to gain more market share which is placing heavy demands on the Management Information Services Department. The direction must be towards anticipating network services and thereby to plan the training needs of staff.

Organisation structures are changing to reflect the new challenges and in doing so are providng implicit career development plans for existing staff and new recruits. Changes are being made during a period of intense activity which requires an act of faith from senior management with regard to the future outcome of the transition. Without doubt communications is undergoing a major amorphosis and with luck should survive to become the fulcrum of the corporate operation.

SESSION 4:
Training Projects

BUSINESS AND ACADEMIC USES OF TELETRAINING

What Nations of the Pacific Can Learn From Present Systems

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Teletraining is a powerful tool which can be manifested in many modes. Common definitions are explained, with a brief listing of needed equipment. Applications of teletraining are presented from business and academic uses. The future of teletraining as a global phenomenon is set forth.

Teletraining is a powerful tool for the delivery of virtually any subject matter to classes of all sizes, anywhere in the world. While the format of teletraining classes may vary and the equipment used may differ widely, the concept is the same. By use of electronic devices, a transmission medium and new teaching methods, teachers can link geographically separated students in real-time learning opportunities.

Implications of teletraining for countries of the Pacific are equally powerful. In light of the vast distances between these countries and the growing need for information exchange in all fields, the implementation of successful teletraining programs can offer a better way to provide present training and the only way to meet training needs as yet unaddressed.

Unsuccessful teletraining programs will do none of the above. It is essential to learn from the efforts of others and adopt proven teletraining models. Knowledge of the basic teletraining modes is a prerequisite to program development. A list of the most popular delivery modes in the United States follows. The opinions of each are drawn from six years of work with clients in six countries presenting hundreds of teletraining courses.

AUDIO ONLY

Audio-only teletraining comprises more than 90% of all present applications. Users represent all disciplines, including corporate, academic and medical. A typical client will use a variety of group conference telephones to deliver instruction to an average of ten sites for an hour and a half session.

AUDIO ONLY - Equipment and Support Materials

Audio teletraining classes are taught using a dozen different conference telephones. Vendors of these products provide operation training for their products, but do not advise on the development of lesson plans or other conversion techniques for the instructor.

Of the dozen or so products used for distance teaching, there is no single, superior device. Choice of equipment for a teletraining program must be made by developing a list of criteria, and compromising at every turn. Despite the limited selection of terminal equipment, many teletraining programs are happily flourishing. Thus, the lack of proper equipment is not an excuse for delaying entry into this exciting new field.

In the late seventies, four wire dedicated networks were popular in the United States, particularly among academic institutions. A dramatic increase in leased line costs and the concurrent development of sophisticated premise bridges have led to an increase in bridge sales. Today a wide variety of bridge features and sizes is available to the buyer. Teletraining clients of the author are usually ignorant of the wide range of choices in bridges, and are cautioned to learn and compare before making a sizable capital investment.

In addition to group conference telephones, an audio bridge and dial-up telephone lines, teletraining instructors often add more traditional tools for program enhancement. These support items vary greatly by program, not so much because of pedigogical dictates, but more often because of budgetary constraints or existing equipment. The following list is in order of most frequent use for teletraining, compiled from the author's database:

1. Handouts

Virtually every teletraining class includes a handout, from a single page outline to a detailed student notebook. Materials can be given out in advance of a program, distributed on-site at the start of class, or periodically handed out during the class for timed release of information.

2. Overhead transparencies

Very popular for teletraining, the overhead transparency or foil is a familiar corporate or academic standby. Its particular advantages in distance teaching include low development and duplication costs, ease of mailing and no compatability problems. Projectors and screens are readily available, even in the most rural areas.

3. Slides

Thirty-five millimeter slides are used primarily by AT&T and in medical programs. Both groups have made a significant investment in slides for marketing or education, and have in-house slide production capabilities. As a rule, most other teletraining clients prefer transparencies.

Slides have advantages as an enhancement to audio only programs. They, too, offer ease of duplication. Slide projectors and screens are readily at hand in most business and educational settings Visual impact is impressive when color and images are combined with flair.

Disadvantages to the use of slides are also numerous. High cost is incurred if a large number of slides must be obtained from outside services; preset slide trays are difficult to mail, yet loose slides can be easily shown out of order. Text slides must be professionally typeset for maximum impact; visual images require a skilled photographer. Many medical clients have complained of the time it takes to develop or locate appropriate slides, compile them to enhance the oral delivery, duplicate and ship them to as many as 15 or 20 participating hospitals. Filing and maintaining a catalog of past slides for repeated use is an additional challenge.

4. Videotape

Many clients already have in-house videotape production facilities. In an effort to cut costs of traveling training programs, business clients have produced and mailed out videotapes on a variety of subjects. If an existing network of compatible machines is in place, teletraining can be a further cost-justification.

Uses of videotape to enhance audio only programs are numerous. A short clip can illustrate use of a machine or any action requiring motion. Tapes can introduce a speaker in a more personal way, prior to an all audio course. Role plays and "how to" and "how not to" vignettes may be dramatized. Finally, portions of rented tapes may be used to present specific segments of a longer audio only program.

5. Other Options

Course content may dictate the use of other, less common, support materials. Frequently classes will include off-line "hands-on" activities which require special equipment or machinery, computers and the like. Medical classes can include the use of wet laboratory specimens. Other science courses distribute student packets containing rock samples, wood fragments, dried flowers or leaves, etc. Support materials used in face-to-face instruction can frequently be adapted for teletraining classes as well.

AUDIOGRAPHICS

The newest and least explored teletraining mode is audiographics. Although this medium has intrigued editors and writers of technical publications, few real world examples of established teletraining programs using these devices exist. Audiographics uses basic audio technology plus an additional real time electronic enhancement. Many examples are given below. The reader should also be aware that while audio only systems are most frequently used multipoint, audiographics systems are overwhelmingly used point-to-point. Although most of these devices have no technical limitations to reaching more sites, users seem resistant to developing multipoint applications. It is likely that teletraining will spur the use of this exciting technology for multi-site training delivery.

Electronic Boards and Tablets

The electronic blackboard has been available for a dozen years, offering interactive graphics displayed on a black and white television monitor. The user simply writes on a blackboard which has a touch sensitive surface. Whatever is written is transmitted over dial-up telephone lines to one or more remote locations.

New products include electronic whiteboards which are similar to the blackboards, but add four color display and hard copy printout possibilities.

Other popular audiographic devices include individual lap tablets for writing or drawing on regular paper. Beneath the paper is a touch sensitive pad which transforms what is written to a color display on the television monitor.

Still Video

Still video systems are called by many names, but qualify as audiographic devices rather than as full video systems. Freeze frame, slow scan and captured frame are terms describing systems which select a camera image, transmit it over telephone lines and reconstruct it at one or more locations Features available for a price include full color, high resolution, preview capability, image recall and computer storage.

Still video systems are often purchased by those wishing to conduct point-to-point technical meetings. The complexity of many systems leads to poor user acceptance and disappointing usage. Teletraining is an excellent way to maximize use of existing still video systems. The visual images possible with such systems provide fine support for formal training. With the addition of such images, it is possible to conduct longer training sessions on a wide variety of topics.

Computers

New computer software has led to the development of experimental teletraining programs. Great promise is seen for programs combining interactive audio with linked personal computers. One obstacle to widespread adoption may be cost. Teletraining is most cost-effective when the number of students to be trained is more than 20 per site. Linked audio and computer systems offer effective training, but to much smaller groups. Pilot programs seem to be highly personalized, with small numbers of single individuals at terminals. Until class size can be increased, audio/computer teletraining may be limited to high need courses for key personnel only.

Combined Technologies

More tools for teletraining are possible by combining existing technologies. Voice and data can be transmitted on the same line if a new modem is used. This halves the cost of transmission for traditional audiographic systems which have heretofore required two separate telephone lines.

Another useful combination is the addition of graphic tablet annotation to still video images. This enables the instructor to use prepared visuals with spontaneous graphic annotation.

Finally, new software and interface advances make possible the annotation of computer-generated images. All of these technology improvements give the instructor many more options for visual enhancement of teletraining courses delivered via audiographics.

MOTION VIDEO - ONE WAY

Wideband technology and satellite transmission offer full motion video to the teletrainer. Of the many ad hoc and dedicated network events in the United States in the past year, it is estimated that nearly 80% were devoted to training. These training events share the following commonalities:

- a large number of participants
- a large number of sites
- wide geographic range served
- point to multipoint transmission
- one-way video image to remote sites
- non-visual audio return from remote sites
- average of a three hour event

Full motion video events draw heavily on techniques and technologies developed for commercial television. Unlike audio and audiographic teletraining, the subject matter of video events often takes a back seat to production values.

Costs are generally higher for a full motion video event. Cost justification is often based on the large number of attendees.

Advantages to the teletrainer include the ability to convey the instructor's personality and image and to establish a sense of presence. Activities showing motion can be well illustrated through a wide range of video techniques. Finally, full motion video eliminates the need for tedious preparation and mailing of visual support materials.

Disadvantages of video teletraining can include reduced interactivity. If the program producer is not aware of questioning techniques for the "faceless" attendees and does not plan for interactivity, the program is in danger of becoming a one way television program. The larger numbers of attendees needed to cost justify this mode can also present problems to an instructor striving for a personalized training experience. Both trainers and professional producers must have a common goal and a grasp of both content demands and effective use of the medium.

MOTION VIDEO - TWO WAY

Full motion video rooms can transmit full color images to and from two locations at the same time. Such rooms are rarely used other than point-to-point and can rarely seat more than 20 persons. These facts, coupled with high transmission costs, make this the least used teletraining mode. However, since it is the most like face-to-face classes, two way full motion teletraining requires the least amount of change in an instructor's present teaching style.

EFFECTIVE LEARNING

The United States government recently conducted an extensive research project comparing learning by teletraining to face-to-face instruction. The State of North Carolina was the site for testing in several teletraining modes for 18 months. The results confirmed findings from all previous research in the field: there is no significant difference between learning from a face-to-face instructor or learning via teletraining. In addition, the researchers found that student satisfaction with teletraining was high and that delivery decisions could be justified when made on the basis of cost alone.

WHAT TELETRAINING IS NOT

Teletraining is the delivery of any formal instruction via an interactive, electronic mode. Confusion arises from consultants who offer "teletraining services" which are actually classes on effective teleconferencing and which are frequently delivered face-to-face. Although teletraining itself may be the subject matter of a given course, it is certainly the delivery mode for many courses unrelated to teleconferencing or telecommunications. This terminology distinction should be made clear when engaging a professional consultant for the development of a distance teaching program.

BUSINESS APPLICATIONS

One of the most successful applications of business teletraining has been developed by Century 21 Real Estate Corporation in Irvine, California. This audio only program uses portable group conference telephone equipment, a commercial bridging service, well developed handouts or student notebooks and occaisionally, slides. Applications have included client events for showing available real estate properties, concluding with bids for actual properties taken by telephone.

A more common use is for internal sales training. Recently, a California-based instructor for Century 21 converted an existing course on relocation/referral services to teletraining delivery. The conversion process included an on-line class for other instructors in California, Alaska and Hawaii. Following the conversion process, the class was taught with great success. More students could be trained, at greater distances, with equal student satisfaction. In addition, the instructor, who had previously had no personal experience as a teletrainer, was enthusiastic. She adapted easily and quickly to the new delivery mode, and by the middle of her first class was concentrating on content rather than technology.

Century 21 continues to add courses for teletraining delivery to its curriculum. After two years, teletraining is a solid part of the real estate giant's training options.

Business applications are so numerous that a comprehensive list is almost impossible to compile. Suffice it to say that every type of business is using teletraining to great advantage, for all types of training. In general, companies whose business is high technology are usually more willing to attempt a teletraining pilot program. However, if equipment selection and program planning are well researched and thoughtfully developed, most businesses can be successful at teletraining.

ACADEMIC APPLICATIONS

In addition to permanent teletraining networks, universities and colleges have developed innovative one time programs to share information and teaching techniques.

One such example is the workshop series developed by the American Association for Higher Education (AAHE) based in Washington, DC. The audio only series was established in 1983 by a grant from the Exxon Education Foundation as an enhancement to the AAHE face-to-face curriculum. Of special interest is the computer literacy presentation of February 1984 titled "Campus Computing Resources for Non-Computing Specialists."

Four subject matter experts addressed the issues with the help of a moderator, yet none of them were in the same geographic location. Eleven colleges and universities "sent" a total of 187 attendees to the two hour workshop. Attendees were actively involved in campus computer literacy issues, which contributed to the lively discussion. According to Dr. Louis S. Albert, coordinator of the project, "Interaction was intensive. In fact, at times it was difficult to distinguish between presenters and participants."

This successful program did not happen overnight. AAHE sought professional assistance in designing its network, training its faculty and producing an event of great quality.

As in the business environment, academic applications of teletraining are numerous and increasing Most systems are found in college and university settings, with community colleges comprising a strong base. Recent pilot programs have begun in secondary schools; specific examples include site sites in Arizona and Colorado. This is an area of great potential, particularly in fields with limited resources, such as bilingual education.

THE FUTURE OF TELETRAINING

Looking into the future, the author sees worldwide expansion of teletraining. With the increasing refinement of teletraining hardware, increased options for shared visual images over great distances and lowered costs, distance teaching can come into its own.

Much remains to be done in combining technologies for the development of multi-media events. Why can't we design training that incorporates full motion video, face-to-face instruction, audio interaction and computers? We are not limited in technology; we seem to be limited in vision. An international exchange of ideas, knowledge and skilled instructors awaits us. Although it will require a change in attitudes and institutions, we will be rewarded by a global educational expansion unprecedented by man.

ON MAKING A MARRIAGE:
INTERACTIVE VIDEODISCS FOR EDUCATION

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Abstract

After a long delay, the widespread adoption of the interactive videodisc by education may be at hand. The potential power of this technology for instruction has been recognized for several years, but practical constraints have impeded its general acceptance. Now there are signs that a combination of technical progress, cost reductions, advances in courseware design, and effective market development will overcome these difficulties. While the advantages of the videodisc are broadly applicable, they may be particularly valuable in developing countries.

For those concerned with teaching and learning, the interactive videodisc has long seemed the answer to a prayer. It appears to have everything: the student can proceed at his own pace; material can be presented with the clarity of good video and with the flexibility of a good computer program. One doesn't merely receive a presentation: he can wrestle interactively with the raw material of the course, and come truly to understand it. The system itself can track the student's progress, test his current understanding of a given point, and suggest help if it's needed. Using the system's combination of presentation, branching, and record-keeping, the teacher can achieve highly individualized instruction without unacceptably large expenditures of time with each student.

The military and many industries have recognized these points for several years, and they have made extensive use of this technology in their training programs.

As current work by the University of Nebraska shows, videodisc technology can provide excellent lab science instruction even when it is not feasible to build or staff a traditional "wet" laboratory.

In spite of this apparent potential, however, the videodisc has been slow to arrive in the world of formal education. A number of reasons may be cited. The early failure of the videodisc as a home entertainment device affected the attitudes of many prospective users, in spite of the fact that neither the technologies nor the applications involved in RCA's ill-fated home system were closely related to the laser optical systems which are used by industry and the military. There has not been a consistent, recognized set of specifications for interactive videodisc systems, and this has caused extreme -- and justified -- wariness. The lack of consistent specifications has of course slowed the development of good programs, and so there arises a chicken-and-egg problem: potential users are reluctant to buy videodisc hardware when little courseware is available, and courseware developers are reluctant to invest in making products for a market that seems small and sluggish. And of course the perennial problem of cost has also been a factor.

Now there are signs that the long delay may be drawing to a close, and that education will begin to make significant use of this medium. Costs are coming down, and there is real interest in attacking the question about specifications. The prospect of using compact disc technology for video and data as well as audio has provided additional complexity, but also a sense of real-world progress. Perhaps most important, there is a new sense of interest by key elements of educational leadership.

Before discussing specific developments, it may be useful to review briefly the state of the art in laser optical videodisc technology. It's characterized by high-quality video recording, with as many as 54 thousand frames on one side of a standard disc. These frames may be either still or motion, or any combination of the two. A key element of the system is that any individual frame can be accessed within two seconds. The recording medium itself is rugged, so that the prospect of disc damage -- even with rather careless handling -- is minimal. Videodiscs and microcomputers go together very naturally, so that one may have access both to the high-quality video of the disc and the extreme flexibility of the computer program. The computer is typically used not only to control the disc, but to provide additional text and graphics, and to track and record student progress. The videodisc may be seen properly as an elegant peripheral of the computer system.

Microcomputer applications need not rely on the conventional keyboard. Numerous programs for training and for point-of-sale use have been designed for touch-screen control, and of course the videodisc is integral to many elaborate simulations involving, for example, full-scale aircraft cockpit mockups.

Of particular interest is the fact that laser optical systems are designed with a capability for two audio tracks, so that a disc may be produced in two languages.

One of the most important recent videodisc projects has been that involving laboratory science instruction, produced by the University of Nebraska. The University has long been a leader in the development of videodisc applications, particularly for education. The Annenberg/CPB Project supported the creation and testing of six laboratory experiments, two each in biology, chemistry, and physics. They were carefully evaluated both for instructional effectiveness and for potential cost-effectiveness by Barbara Gross Davis. Data were collected from nearly 700 students: 506 performed videodisc simulations and 183 used traditional "wet" laboratories. Forty-five instructors in seven colleges and universities took part, using the discs as they chose. Dr. Davis found that students using the videodisc simulations consistently scored as well or better than those who used the traditional labs. Furthermore "the videodisc group worked through their experiments more quickly and were able to experiment with a wider variety of conditions than the traditional lab student." (1) She found a high degree of acceptance among faculty members, although professors at major research universities, where laboratories are more readily available, tended to believe that the discs ideally should supplement lab experience rather than replace it.

Dr. Davis noted that completed discs can be duplicated inexpensively and that costs of hardware systems are expected to drop to the $1000-2000 range, down from their present typical level of about $3500. Costs of producing the discs vary enormously, depending on the techniques necessary to present a given lesson. She cites the fact that the cost of microcomputers has declined about 30 percent "over the last several years," while the costs of videodisc players have fallen about 20 percent. Both are expected to decline farther. Already it is considerably less expensive to employ videodisc instruction than to equip and staff a new wet lab, and "the recurring costs of personnel and materials are much greater for a traditional laboratory than for videodiscs. In that case, over time, the videodisc approach would become cost-effective. The amount of time needed to reach a break-even point is not clear at this time." (2)

Interest in the videodisc as part of science instruction is also reflected in the current SciLab Project of the National School Boards Association. The project, headed by James Mecklenberger of the Association, seeks to apply videodisc technology as an effective and economical part of teaching laboratory science in secondary schools.

In some ways, science instruction is a natural way to begin the major use of videodisc technology by education. The medium is well suited to demonstrating variables and the results of experimental choices. Furthermore, there's an increasing demand for science instruction but often not the wherewithal to equip expensive traditional laboratories. Nor do we have enough fully qualified science teachers. The videodisc offers an opportunity for high-quality teaching, cost-effectively, within our practical constraints.

There are of course many other areas in which videodisc technology shows promise. For example, with 54 thousand frames per side, a single disc can provide a massive archive of graphic art, any frame of which is instantly accessible. By varying the microcomputer program that controls the disc, the works of art can be studied by historical period, by artist, by subject matter, by the artist's school or style, or by whatever other category the teacher or the builder of the curriculum may choose.

It appears, then, that videodisc technology could be on the verge of some serious applications in education, perhaps to respond to specific shortages of facilities and people -- as in science instruction -- or to enhance the resources available to teaching, as in the art archive example noted above. In either case, the videodisc would offer the opportunity to apply teaching techniques which take advantage of the system's remarkable capacity for interaction.

In spite of these signs and portents, however, one might properly ask why we should expect the videodisc to make a dramatic entrance now: after all, the technology has been available to education for several years, but to date only the military and industry have applied it seriously. Although that skepticism would be understandable, it would be misplaced, because the elements of the situation have changed.

First, there has been a change in the demands made on education itself. In the U.S. there is a strong renewed interest in quality education and a distinct shift in emphasis toward the basic subjects of language, science, and mathematics. While financing has not entirely kept pace with this shift, it is clear that the society is prepared to pay for an education that it considers appropriate. Proven, cost-effective technology may be very important because our capacity to teach these subjects has eroded over the past several years, and today's determination alone will not provide the people or the equipment that are needed.

However, there have been other times when one might have used a similar rationale for the advent of technology in education, and the results fell far short of the promise. Why should this situation be different? Again, times have changed.

The implications of the Information Age are beginning to sink in. Within societies and between societies, there has arisen a serious new concern:

the spectre of a permanent underclass of the information poor, with a clear recognition that to be information poor is to be economically poor. This spectre has tended to focus attention on the importance of education, particularly those elements of education that are clearly related to mastery of information work: language, mathematics, and science. The problems of education are made even more complex by the fact that the clientele is diversifying: job retraining and the continual updating of skills have become imperatives for many -- including both bluecollar and professional workers -- who may have thought their education was complete. Given such pressures, it would be a wonder if education were not taking a close look at ways in which technology can help. Furthermore, the people of the Information Age are much more comfortable with technology itself than were their predecessors. As long as a given technology is not seen as a threat to jobs, today's parents, teachers and administrators are ready to use technology that shows promise; witness, for example, the remarkable rise of microcomputers in schools even in the absence of adequate software in many areas.

As evidence of current interest in videodisc technology, one might cite again the SciLab Project of the National School Boards Association, which is hardly a group to push technology for its own sake.

Perhaps even more important in the long run will be the newly formed Interactive Videodisc Consortium, which presently consists of eight educationally oriented public television licensees in the U.S. The consortium is confronting head-on the chicken-and-egg problem involving hardware and programs. Its first major project, funded by the Corporation for Public Broadcasting, concerns improved system specifications for interactive videodisc systems. While no education group can establish de facto standards for a technology, the IVC is analyzing the elements of these systems, watching such developments as the military's EIDS videodisc specifications, tracking industry trends involving development of the component technologies, and working toward a consensus about the capabilities and technical characteristics of systems that meet the needs of education. During the fall and winter of 1985-86, the consortium will involve a wide range of interested parties from education and industry in its inquiry. A draft working paper, "Video Computing Systems for Education: Expectations and Specifications" has been prepared by the project's principal author, Brian Kahin, Coordinator of the Communications Forum at MIT. (3) The Consortium is also at work on the other half of the chicken-and-egg issue: it will seek production of educationally valuable videodiscs that play on systems which meet the IVC specifications.

None of this should suggest an attempt to freeze technological development. Rather, the effort is to encourage educational adoption of this remarkable technology by establishing a consensus about what systems should look like in the near- to mid-term, while providing some reasonable, continuing projections about future developments. It should be obvious that those responsible for education's investments must have confidence that hardware and courseware will be compatible with each other and will have useful lives long enough to justify their expense.

While the developments reported here have taken place in the U.S., the conditions described are at least as pertinent in many other countries. Needless to say, the American shortage of classroom teachers and proper laboratory equipment must pale to insignificance in comparison to the problems of many other nations. And, for example, the science laboratory simulations produced on videodisc at the University of Nebraska have been adapted and tested also in Indonesia. The videodisc's dual audio track makes it possible to produce a disc for use in two languages, simultaneously and inexpensively. While one should not minimize the potential problems of introducing relatively vulnerable equipment into countries where maintenance is difficult and power may be unstable, neither should we assume too quickly that a technology's potential advantages are unattainable.

In summary: we may be on the verge of realizing the great potential of videodisc technology for education. Technical advancements and cost reductions have made these systems both more appropriate and more attainable, and the requirements of modern education virtually invite technological assistance. Such developments as the Nebraska experiments, the Interactive Videodisc Consortium, and the SciLab Project are indicators of growth in the U.S., and it appears that the advantages seen for U.S. education would be at least as applicable in many other countries.

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(1) Barbara Gross Davis, Ph.D., Executive Summary, "Videodisc Science Laboratory Simulations" report to the Annenberg/CPB Project, March 1985.

(2) Op. cit., p. 13.

(3) Brian Kahin, "Video Computing Systems for Education" Expectations and Specifications," unpublished draft working paper. Washington, D.C.: Interactive Videodisc Consortium, 1985.

TELECOMMUNICATIONS TRAINING NEEDS FOR THE CHANGING TECHNOLOGICAL ENVIRONMENT

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1. Abstract

This paper deals with the need for determining education and training requirements within telecommunications organizations, based on long term and short term goals identified through the strategic planning process. Models of satellite and terrestrial telecommunications training techniques together with employee and customer training programs are also discussed.

A. ASSESSMENT OF TRAINING NEEDS

1. ORGANIZATION GOALS

For any telecommunications organization to survive in today's business environment it is essential that corporate goals be established, and that effective action plans are put in place, in order to reach those goals within acceptable time frames.

Strategic Planning is the first step in the process. This process will determine the general overall direction the organization will take in the long term. Many telecommunications organizations are in the process of conversicn from electromechanical step by step technology to more highly mechanized analog and digital technology. Once this conversion process has begun, the organization is committed to the development of the support systems that are necessary for the successful integration of these newer technologies into the existing telecommunications operating system.

Subsequent to this step, however, a series of Short Term Goals, in the five to ten year range will become evident as the building blocks to achieving the long range goal identified in the strategic planning stage. These short term goals should indicate changes necessary to various departments within the organization such as operations and maintenance, engineering, customer service, and a host of other functional support groups.

Having now reduced the goals to the individual areas of responsibility, Implementation Plans can be formulated. These broad range plans should map out the process of introducing the changes. Many different departments are usually affected and consideration must always be given to the impact on the overall telecommunication system operation.

In the final stage, the Action Plans are developed. These plans are more specific and will identify the individual steps required of each department within the organization which would be impacted by the proposed changes.

For the astute organization, concern for the education and training necessary to succeed with their implementation and action plans is a high priority and shares equal importance with other corporate concerns.

The most important resource of any organization is its employees, and their requirement for training in our ever changing technical environment is always a necessity. Any telecommunications organization not recognizing this need takes the chance of losing not only business opportunities, but also employees to organizations who ensure that their employees' performance is up to the level demanded by the new technologies.

Each organization should critically examine its position in order to establish education and training goals. To do so, it is necessary to determine where the organization is at present, where it is headed, when it wishes to be there, and how it will get there.

With these decisions made, the corporate planners can bridge the gap between where their organization is at present and where they want it to be in the future.

2. TECHNICAL ENVIRONMENT

It is no surprise to anyone involved in the industry that telecommunications companies operate in a very technical and complex environment. In both Terrestrial and Satellite communications, technological advances are rapid. Digital technology is having a major impact on our industry. While laser light and fiber optics are newer challenges to the terrestrial telecommunications industries, the service capacity of communications satellites has increased 170 times since the advent of the Early Bird Satellite in 1965. The pace of technological change is not likely to decrease but rather will increase. To keep abreast of these changes, the forward thinking corporations must make plans to acquire the new skills and knowledge to operate effectively in the new technologies.

To proceed with the steps which follow, organizations will have to determine if they possess the necessary expertise to make the decisions that will put them on the right course toward their training and education goals. Should this expertise be lacking, assistance can be obtained from professional training organizations.

3. IDENTIFYING DESIRED SKILLS & KNOWLEDGE OF MANAGEMENT AND STAFF

Once the action plans are completed, the organization should then consider what skills and knowledge are required to achieve the desired goals. This can be accomplished through the process of Job Analysis. By analyzing the specific performance within each job responsibility, a highly detailed list of required skills and knowledge can be obtained. The result is called a Performance Based Job Description. With this in hand, it is then possible to identify the level of skills and knowledge that the newer technologies will demand of the organization.

Required skill levels could be wide ranging, from such specific skills as maintenance of a certain type of electronic switching equipment, to the requirement for providing technical induction training to managers, both technical and non technical, to increase their awareness and effectiveness in the changing environment.

4. INVENTORY OF EXISTING SKILLS & KNOWLEDGE OF MANAGEMENT AND STAFF

Using the Job Analysis process outlined above, the organization can then assess the existing level of skills and knowledge present within its work force. At this point, consideration should be given to the perishable nature of some skills wherein they are lost if not used. This in-depth process will likely reveal areas where additional training is required, while other areas may prove to be sufficiently competent and no further training would be cost beneficial to the organization. In many cases, the process will also indicate departments or even specific employees who are capable of participating in the training of other personnel.

5. BRIDGING THE GAP BETWEEN EXISTING AND DESIRED SKILLS AND KNOWLEDGE

What remains after the identification and inventory stages of this assessment process, is the gap between the desired skills and knowledge necessary to cope with new technology and the existing skills and knowledge present within an organization. This gap can often be bridged by education and training programs.

Some critical questions must be answered at this point. What type of training is required? Is the training available within the company or will it have to be contracted out? Does the required type of training exist or will it have to be custom produced? What will it cost? Over what period of time will the training be effective? How many employees should be trained? Can the training be brought to the organization or will employees have to travel to the training location? These and many other decisions regarding the specifics of the training are best made with the assistance of specialists in the training and education field.

To illustrate how one telecommunications organization operates their programs, let us look at the Hughes Space and Communications Group. Hughes specializes in effectively training their customers in all aspects of communication satellite technology. Their training is designed to equip the Satellite Systems Operators with the skills and knowledge they require to independently operate and maintain the systems throughout their expected life, and to plan for expansion and technological improvements.

B. A REVIEW OF HUGHES SATELLITE CUSTOMER TRAINING

Training Requirements for the Satellite Communications Environment

1. OVERVIEW OF HUGHES SPACE & COMMUNICATIONS GROUP TRAINING

Hughes Space and Communication Group's experience with communication satellite training dates back to the early Intelsat satellites in the mid-1960's. Our early training activities were involved with the fledgling Intelsat organization to understand the mechanics of geosynchronous satellite operations and to implement these operations.

During the intervening years as the satellite business proliferated, Hughes has gained considerable experience and expertise in training our customers in all aspects of communication satellite technology. These customers include U.S. domestic satellite operators such as Hughes Galaxy, AT&T Satellite Business Systems, Western Union, as well as other national satellite system operators such as Indonesia, Mexico, Brazil, Canada and Australia. Training of our overseas customers has resulted in a significant technology transfer to them and the establishment of competent national satellite system organizations and personnel.

The training has included satellite and ground station system engineering and analysis, operations and maintenance. These will be discussed in detail further in this paper.

2. TRAINING REQUIREMENTS

The training requirements fall into three categories:

(a) Training of new satellite customer operating organizations.

(b) Follow-on and new technology training for existing customer satellite operators

(c) Training of potential satellite operating organizations.

Category (a) is the major training activity for Hughes S&CG and it emphasizes customer personnel involvement during the early days of the program development. The two principal types of training provided are Factory Training and On-Site Training.

Factory Training is conducted at the Hughes S&CG facilities in California and is usually limited to senior customer engineering, planning and operational personnel. After receiving classroom lectures on specific engineering subjects, the students are assigned to the program development areas and become part of an integrated work force. This method of training has proven to be very effective as it provides customer feedback during the initial program phase when it can best be implemented and insures that the customer and the contractor work on a team basis.

On-site training is conducted at the customer's facility and is primarily intended for the customer's operational personnel. This training consists of both classroom lectures and practical laboratory instruction on the operational systems.

Category (b) consists of training, usually requested by the customer to upgrade the skills of his workforce, or, provide instruction on new equipment or technology.

Category (c) training is to those potential satellite operators who, as an aid to their planning process, have a need to understand the various facets of the satellite communications business before they make major commitments of capital and resources.

3. TRAINING COURSES

The training courses offered by Hughes S&CG are oriented toward communication satellite technology. The catalog includes satellite system engineering and analysis, communication systems, earth station systems engineering and design, telemetry, tracking, command and monitor (TTC&M), facility engineering, systems operation and maintenance, mission operations, launch operations, satellite control operations, orbital dynamics, operations management, program management, configuration management, parts management, product assurance and administrative procedures. Specialized training such as terrestrial network planning has been subcontracted to such organizations as B.C. Telephone Company in Vancouver, British Columbia, Canada.

4. TRAINING TECHNIQUES

All training phases include classroom lectures at either the Company's or the Customer's premises. Instructors are provided by members of the technical staff and the training is coordinated by the training organization. Most lectures are videotaped for viewing at a later date and standard audio visual media is utilized to a great extent.

In the early part of the program development, key client personnel are integrated into the workforce where they receive practical training on the developing systems. This has proven to be very effective as they are "in on the ground floor" and can carry this experience through to the operational phase.

In addition to classroom lectures, practical laboratory instruction is provided to give students "hands-on" experience to ensure the lesson has been learned. This instruction is particularly important to those personnel required to operate and maintain the system.

As the system becomes operational, a disciplined on-the-job training (OTJ) program is initiated so that personnel may become proficient in additional tasks.

5. DEVELOPMENT OF TRAINING MATERIALS

Training plans and course outlines are prepared by the training organization in coordination with the needs of the customer. Instructors are assigned and the training material is prepared in a standard format. The instructors present the lectures in an interactive manner utilizing audio visual aids, viewgraphs or 35mm slides. Each student is given a student guide which contains copies of the visual material and text.

6. STUDENT SELECTION CRITERIA

The criteria for student participation in the training programs is established by the Hughes S&CG training organization. The selection of students is at the customer's discretion. However, in many cases, Hughes training experts have been requested to participate in the student interview and selection process. This has proven to be beneficial to both parties as the customer may not have the experience to select the appropriate candidate and the trainer has the advantage of picking the most qualified students.

7. SPECIFIC CUSTOMER TRAINING PROGRAMS

Personnel training is regarded as a significant factor for the development and maintenance of an efficient communication satellite system operation. Hughes has recognized this factor and has provided comprehensive training programs to each of its satellite customers, each program being designed to meet the specific needs of the customer.

The introduction of the Indonesia Palapa system in 1976 was one of the earliest challenges. Personnel to operate and maintain two satellites, a master control station, and thirty-nine ground stations had to be trained, mostly from the ground up. Over two hundred personnel were trained in less than one year, with skills ranging from station managers, orbital analysts and systems engineers, to ground station technicians. The program was an unqualified success and many lessons were learned; all of which have been applied to subsequent programs.

Training programs of a similar complexity have been conducted for the Mexican Morelos and Australian Aussat programs. In each case, approximately fifty specialists have been trained in varying disciplines. Specialized training in satellite control, orbital dynamics and mission operations has been provided to Canadian and Brazilian personnel in support of the Anik and Brasilsat programs. Operational training for U.S. domestic satellite operators such as AT&T, Western Union, Satellite Business Systems (SBS), and Hughes Galaxy has also been provided with follow-on training conducted upon request.

8. PERCEIVED FUTURE NEEDS OF TRAINEES AND USERS

With the increased utilization of high technology satellites, computerized control and display systems, and highly reliable digital communication equipment, the man-machine interface is becoming increasingly automated and the systems more reliable. The trend will be toward smaller but highly specialized staffs to operate the communication satellite systems of the future. The challenge will be to match the needs of this new breed of trainee.

C. TRAINING, AN INTEGRAL PART OF GROWTH

1. AN OVERVIEW OF B.C. TELEPHONE'S TRAINING METHODOLOGY

A look at a typical planning, design, implementation, and operational model of a telecommunications organization and the critical role of training in its success.

The British Columbia Telephone Company, situated in Western Canada, is a suitable model to demonstrate the critical role of training in the changing technological environment.

British Columbia's area is vast - 950,000 square kilometers. Much of it is mountainous. Its 12,000 kilometer coastline is dotted with about 6,500 islands. Its climate varies from Mediterranean mild on the southwest coast to summer and winter extremes of desert heat and polar cold in its interior and northern regions.

B.C.'s population distribution is uneven, with roughly 60% of its nearly 3 million residents living in the southwest corner. The remainder are in smaller communities, rural and island areas and remote villages, often separated by great distances.

The natural resource base of the province's economy occasionally results in explosive regional growth patterns, which require swift and effective response to provide essential telecommunications services.

The public network serving this territory includes more than 280 local and 14 long distance switching centers, many of them employing digital technology. Fiber optic systems connect many of these facilities.

The network has more than 14,000 kilometers of radio relay transmission facilities and 200 radio microwave sites, many on mountain tops. It has 13 operating centers and, in one of the world's largest public marine and mobile radiotelephone networks, employs 200 radio terminals.

B.C. Tel owns and operates the telephone system of British Columbia, which is Canada's second largest. This system is an integral and essential part of Canada's national telecommunications network which it and its corporate affiliates have helped to create.

2. B.C. TEL'S MAJOR CHALLENGE

Since the 1970's, B.C. Tel has gone through a major upgrading and conversion of its switching system. In some areas this entailed replacing the step by step switches initially with analogue electronic equipment and then to digital electronic systems. In other areas the conversion was done in a single step, bypassing the analogue electronic equipment stage and going directly to digital electronic systems.

3. HOW THE CHALLENGE WAS MET

Obviously, this conversion program was a major undertaking for the company which would impact on virtually every department. While action plans were being formulated, it became very clear that education and training would play a vital role in the success of this conversion process.

These action plans helped assess the level of desired skills and knowledge that would be required. Because the company was heading into a new technology, this assessment, when compared to an inventory of existing skills and knowledge, showed a considerable gap. Once identified, plans were made which would bring the employee's performance up to the required level. These plans included a critical look at the state of the education and training within the company at that time.

4. THE RELATIONSHIP OF THE CHALLENGE AND THE TRAINING

It is appropriate that this particular major project be related on the basis of the company's approach to education and training which developed during the same period of time.

In the early 1970's, the company's training facilities were small and located in various places around the city of Vancouver and throughout the province of British Columbia. Classroom equipment and facilities were usually inadequate. Each training discipline operated in relative isolation, and each reported to different functional departments in the headquarters organization.

The educational sophistication of these groups varied as did their location. This contributed to the lack of any recognizable standard for course design and delivery. Although instructors had considerable expertise in their fields, the course structure and method of instruction was often up to the individual instructor.

This was an extremely costly and inefficient way to approach the field of industrial education. Also inherent in this approach, was a lack of formal and visible commitment to education and training. Total dependence on the financial health of the organization resulted in extreme fluctuations in demand. The results of this type of training environment were inconsistent with achieving the major upgrading of skills and knowledge that was necessary.

Over the years, several attempts were made to consolidate the training function. In the spring of 1977, a group of training managers presented unrefutable data that a dedicated, centralized facility and organizational structure should be formed. A decision was reached to make a very substantial commitment to the education and training of all company personnel.

In April, 1978, the training facilities were centralized and moved to a new location in the heart of the city. With an area of 5,000 square meters, the new facilities provided 35 classrooms, instructor and training specialists office space, and an administrative staff support system. Hands-on training equipment available in the classroom included everything from magneto telephones to electronic switching and transmission systems.

In December, 1983, the Education Centre moved to its present, more central location in Burnaby, British Columbia. The modern 15,000 square meter building provides 64 classrooms, associated office space and a host of advanced training equipment such as complete digital switches, radio and microwave systems, fiber optic and satellite communication systems, many types of switchboards, computers and various types of data communications equipment. Also featured are computer based types of instruction such as Timeshared Interactive Computer Controlled Information Television (TICCIT).

5. THE SYSTEMS APPROACH TO CURRICULUM DEVELOPMENT

Almost coincidental with the formation of the centralized Education Centre in 1978, was the adoption of a systematic program design model utilizing a "Criterion Referenced Instruction" approach. This model forms the basis for the instructional design and delivery process and in addition, assists in defining the organizational structure within the Education Centre.

The model consists of four major phases:

1. Analysis
2. Design
3. Production
4. Implementation

The very concept of a "systems" approach to curriculum development dictates the existence of a front end or Analysis phase called a "Needs Study". This involves taking a request for training and rewriting it to define the training goals in observable and measurable terms. It is at this point that the "problems" are analyzed to identify those which are caused by a lack of skill and/or knowledge, and which can be solved by the design and implementation of training. Those "problems" caused by something other than a lack of skill or knowledge fall outside the jurisdiction of Education and are dealt with by other agencies within the organization.

If, as a result of a Needs Study, training appears to be a plausible solution to the performance "problem", the second stage of the Analysis phase is conducted. This is the Task Analysis.

In Task Analysis, the "problematic" performance (perhaps a whole job) is broken down into its simplest components. These are the skills and knowledge required by an employee to perform at minimal competency. Finally, the skills or learning components are categorized by type: verbal information, intellectual skill, motor skill, cognitive strategy, and attitude. (These categories are used later in the design phase to select appropriate instructional resources, methods and media.)

This is a very brief description of the Analysis phase of the development model. Records accumulated during this phase become the working documents for the second phase of the model: Design.

The most obvious quality of the Design phase is its strict performance orientation. On the basis of the performance components identified in the Analysis phase, the course developer designs Instructional Objectives. Then Tests are designed to assess the student's achievement of each objective. Only when this has been accomplished is the course developer ready to acquire or produce the Resources and Reference necessary to enable the student to meet the performance requirements of the instructional objectives. Because these objectives are based on job related performances and standards or Criteria, and because the course content is selected on the basis of its value in enabling students to meet these criteria, this method of course design is known as "Criterion Referenced Instruction".

The final step of the Design phase is to select Instructional Methods and Media most appropriate to facilities the development of the particular types of skills categorized in the Analysis phase. Here, the course developer selects from a wide variety of both active and passive methods and media, as well as various types of job aids.

In order to enhance the efficiency and the acceptance of the training course, critical decisions regarding the selection of methods and media must be based on recognized adult learning theories.

Once the Design phase has been completed, the Production phase begins. In this phase, such materials as Student manuals, audio and visual media, tools and equipment, and the Instructor Guide are brought to life. This process is guided by the information gathered in the Analysis phase and the decisions reached in the Design phase.

The final phase of the development model is Implementation. Before the course is made available as a standard offering by the Education Centre, it is tested by a group made up of both subject matter experts, and of representative members of the intended student population. It is not uncommon that some components of the course are changed as a result of these test or Pilot courses. Because of the rapid technological advances and the consequent procedural changes inherent in our industry, most courses require ongoing monitoring, evaluation and revision.

6. THE EVALUATION PROCESS

Training evaluation is a process which is frequently talked about, but very seldom done. The Systems Approach to Curriculum Development incorporates two possible types of evaluation:

1. Formative, or Process evaluation; and
2. Summative, or Product evaluation.

Formative evaluation, as the name implies, relates to evaluation that takes place throughout the stages of a program's development. Within B.C. Tel, it is an ongoing process whereby an independent evaluator works with the course developer to ensure that the procedures in the design model (The Systems Approach to Curriculum Development) are followed. Experience has proven that the more stringent the formative evaluation, the better the product.

This product, the training course, may then be subjected to the second type of evaluation; Summative Evaluation. It is within this realm that most of the talk of evaluation takes place. It is generally agreed that summative evaluation can assess a training course at one or more levels:

1. The students' subjective reaction to the course;
2. The amount of student learning that occurred during the course;
3. The degree to which the students were able to transfer that learning to their jobs;
4. The quantifiable effect (positive or negative) that the transferred learning had on the organization as a whole.

The ultimate purpose of any training evaluation activity is to provide data for decision makers regarding stopping, continuing, or changing a training program.

7. THE SYSTEMS APPROACH AND THE TRAINING

These systematic techniques were used in the development of the training required for the British Columbia Telephone Company employees to meet the challenge of the technology conversion. Although the example appears to be oriented around the technical training of digital switching, in fact, the Systems Approach, or any performance based course design model, has utility in any training situation.

D. CONCLUSION

1. MEETING THE NEEDS OF A GROWING COMMUNICATIONS ORGANIZATION

One of the critical aspects of involvement in the communications industry is the high rate at which technological change takes place. Planning and goal setting are important priorities which help the organization anticipate its requirements for personnel and for training. Whether an organization stays the same size or area of endeavour, the impact remains the same; training, in some form, will be a necessity.

It is crucial that communications

organizations have access to the most up to date training that is available. Decisions regarding the availability of in-house training and education versus using outside sources should be made with care. The costs of course development, delivery, and maintenance are high. These costs must be balanced against the number of potential students requiring the training. This type of cost benefit analysis will usually indicate that the use of organizations specializing in technical training are not only cost beneficial, but they are able to provide state of the art courses and programs where and when they are required.

2. USE OF EFFECTIVE TRAINING METHODOLOGY

Everything from the selection of students and curricula, to the evaluation of the results of training should be an integrated system. Adult education is a highly complex field and many factors must be weighed when course designs are being formulated. Direct involvement by the client organization is most beneficial at this time. During the design and production stages of the program, a proven system of curriculum development should be used. This ensures that the end product will provide the type and quality of training required.

Student selection and motivation is also important. Even the most carefully designed and executed training program can fail if the student selection process is poor. Students who do not have the necessary prerequisites may not be able to master the material presented, and unmotivated students have little encouragement to learn.

3. SELECTING A TRAINING ORGANIZATION TO MEET YOUR NEEDS

Once the decision has been reached to make use of a training organization, the next step is to select the one which is best able to satisfy the training and education requirements of the communications organization. A checklist by which to judge a training organization would include these items:

- What are the qualifications of their instructors and developers?
- Do they use a proven system for curriculum development?
- What type of training is required?
- Does the required type of training exist or will it have to be custom produced?
- What is the delivery lead time?
- What will it cost?
- Can the training be brought to the organization or will employees have to travel to the training location?
- Is there any follow up to check the effectiveness of the training?

These and many other decisions regarding the specifics of the training must be satisfactorily resolved before a mutually satisfactory relationship can exist between the client and the training organization.

Round Table

"International Cooperation Among Training Organizations: Private Industry, Academia and Government"

Notes

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